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Contents

EDITORIAL—
Ends and Means 575

ARTICLES—
Current-Locus Diagrams. By C. B. Wyatt, Assoc.M.C.T., A.M.I.E.E. . 577
Lamp Industry Research. By B. P. Dudding, M.B.E., Ph.D. . . . 591

REPORTS—
I.E.E. Inaugural Meeting . . . 583
New Zealand's Power Position . . 586
Heat Pump Applications . . . 593
B.B.C. Television Masts . . . 594
Engineers and Social Progress . . 603

NEWS SECTIONS—
Personal and Social, 589; Commerce and Industry, 595; Financial, 604; Electricity Supply, 608; Contracts, 611.

VIEWS ON THE NEWS . . . 585
CORRESPONDENCE 587
RECENT INTRODUCTIONS . . 600
NEXT WEEK'S EVENTS . . . 607
NEW PATENTS 609
Classified Advertisements 59
Index to Advertisers 82

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ELECTRICAL REVIEW

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Ends and Means

THE SPHERE OF ENGINEERS

IT is sometimes alleged that engineers live in an enclosed atmosphere which cuts them off from many human interests. Engineers for their part may claim that a trained appreciation of the sequence of cause and effect makes the society of those with similar outlook more congenial and that their association with various social groups in factories (even if only during working hours) gives them an insight into human relationships that is not enjoyed by all. They may point to the value of belonging to what amounts to a professional brotherhood, which enjoins on them the observance of the highest code of conduct towards the public, and to traditions often expressed in such homely terms as " keep the supply going " and " do not let the customer down."

Material and Moral Development

Engineers can also find just pride in the engineering achievements that have enormously advanced the standard of living in more backward countries. Further, they may reflect, gloomily, that their very efficiency is partly responsible for material progress having so greatly outstripped moral development of the human race or, more happily, that it has given them opportunities now for aiding very substantially in the reconstruction of war-ravaged countries.

For the last-named purpose the most urgent task appears to be the augmenting of power resources everywhere. In his presidential address to the Institution of Electrical Engineers, reported on page 583, Mr. T. G. N. Haldane gave a number of examples of what is being done in this way, the most important of which involves transmission at very high voltages with its attractive possibilities of a Continental grid and the participation of Great Britain in it. In this country the 132-kV grid has provided experience in the building of high-voltage equipment that has undoubtedly aided export. The projected 275-kV reinforcement on the comprehensive scale advocated by Mr. Haldane seems necessary for maintaining British reputation abroad, apart from home requirements, in view of technical advances.

Science and Politics

In gatherings of engineers, national and international, one is conscious of a feeling that the advances they have made possible are continually hampered by political considerations. The resulting sense of frustration has sometimes led to the idea that engineers as such should largely control State policies. This brings us to the " not by bread alone " second theme of the presidential address. In this it was pointed out that science and its applications are not enough. Their findings can be logical and precise only because they are limited to a restricted field. Beyond this are those obscure springs of action, the irrational though not necessarily ignoble impulses that are nowadays recognized as accountable for much the greater part of human activities.

In these engineers share, since their more logical work occupies only a portion of their time. They have the legacy of the instinctive knowledge (in whatever disguise)

held by the human race that there is something more in life than the attainment of good material standards. Mr. Haldane suggests many ways in which broader early education can foster an attitude of mind that makes it easier to understand more fully the meaning of the idea that we are members of one another.

There is nothing in all this to abate by one jot the need for a scientific approach to the problems of life or for engineers to do what is in them to improve the material lot of mankind, still so sadly below what it could be. But men can be masters and not slaves of civilization only if they realize that mechanization is only a means to an end.

FARM ELECTRIFICATION

THIRTY or forty years' work is involved in the electrification of the 146,500 farms in England and Wales, according to Mr. W. A. H. Parker, electrical consultant to the National Farmers' Union. This apparently is related to the present rate of progress which is retarded by the difficulty of obtaining overhead-line equipment, particularly poles, and, in common with all electrification work, by the reluctance to put further burdens on plant already overloaded. Mr. Parker referred to the five-year plan which the N.F.U. had formulated which would cost the electricity authorities £45 million, a further £27 million being found by the farmers for equipment. A memorandum has been sent to the British Electricity Authority calling for a speeding-up of rural electrification.

ACCOMMODATING POWER STAFF

IN many directions industry is handicapped by lack of accommodation for employees, or would-be employees. It prevents the movement of labour which is so badly needed nowadays so that undermanned works in one area are unable to secure surplus workers from other districts. The same consideration applies in the higher ranks. For instance, the South Eastern Division of the B.E.A. needs several additional technically qualified men at the new Kingston power station but there are no houses available for them. It has asked the Kingston Corporation to give such cases special consideration but the Corporation is naturally doubtful about placing the claims of newcomers above those of local people. There is a good case for the provision of houses as part of the plan for a new power station; the expense would be almost negligible in comparison with the total cost of the station.

COMPENSATION REGULATIONS

WRITING to the *Daily Telegraph*, Col. O. E. Crosthwaite-Eyre, M.P., complains about the delay in the production of regulations for the payment of compensation to employees of electricity undertakings who have suffered loss of employment or worsening of conditions because of the nationalization of electricity supply. We believe that the change-over has not caused distress to a great number of people but we agree that those who have been affected should not have to wait for redress. Regulations governing pensions have been published; this matter is surely of greater urgency.

B.E.A. AND TRADE PRESS

WE welcome the assurance given in the first number of the *B.E.A. Monthly Journal* that the technical and trade press is still regarded as the appropriate channel for the dissemination of news and articles covering the British Electricity Authority's activities. We also appreciate the kind tribute paid to the press in the same note and welcome the *Journal* as complementary to our work, but with a particularly " domestic " appeal to members of the Authority's staff.

DOMINION CO-OPERATION

UNCERTAIN supplies of coal and oil alone justify the New Zealand Government in its policy of placing main reliance on the country's abundant water power resources for electricity generation, in spite of the shortage caused by recent exceptional droughts. In addition, however, the Dominion Government takes notice of the expressed wish of United Kingdom authorities that it should not at the present time seriously encroach upon the field of steam-electric plant, which is vital to the Mother Country's needs. Efforts are being made to press forward as rapidly as possible with a series of large hydro-electric developments so that even in periods of drought there will be a margin of capacity available. Investigation is also proceeding into the possibility of making use of natural steam for electricity generation.

Current-Locus Diagrams

Of Polyphase Induction Motors Connected in Synchronous Tie

By C. B. WYATT,
Assoc.M.C.T., A.M.I.E.E.

THERE are various analytical methods of assessing the performance of polyphase induction motors connected in synchronous tie. This article aims at showing how graphical methods may be developed by a vector treatment of the circuit conditions.

Two identical motors connected in synchronous tie will run at exactly the same speed within the torque limits of the tie. Any torque difference between them produces, however, displacement between their rotors known as the torque angle. It is convenient to examine their performance at a fixed value of slip whereby the current loci of both machines may be defined as a function of the *total rotor displacement angle;* this may be done under any desired condition by producing current-locus diagrams at appropriate values of slip. This is the converse of methods which obtain the torque angle by defining a hypothetical phase shift of voltages with rotors in the same relative position. The concept of current loci as produced by varying torque angle at constant slip has been used by Lund, Richter and others, but it will be shown how such methods follow from the solution of a simple network which treats the interconnected machines as phase-shifting transformers.

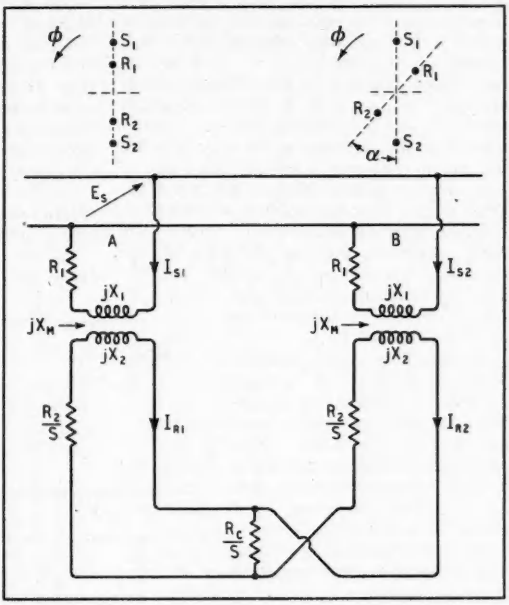


Fig. 2

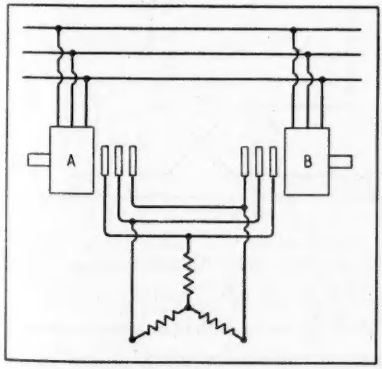


Fig. 1

Fig. 1 refers to a simple type of synchronous tie which employs a three-arm resistor common to the two rotors. Since it is the ohmic drop across this resistor which provides the tie, an appreciable loss must be dissipated in it. The motor connections are represented diagrammatically (one phase only being shown for simplicity) in Fig. 2, the familiar " equivalent-transformer " diagram with the additional property of mutual rotor phase shift represented by the angle α. Under the rotating-field concept, movement of a rotor

with respect to its stator produces a phase shift. This can be defined in the vector equations by employing the vector operator $e^{j\alpha}$ to act upon the mutual reactance jx_m where α is the angular movement defined in magnitude and direction with respect to a fixed datum. It is assumed that the rotor of motor A is fixed, while that of motor B is rotated through the angle α, as shown by the mutual position of the reference stator and rotor conductors S_1, S_2 and R_1, R_2 above motors A and B. The network may then be solved for any common motor slip, provided the circuit constants represent that value of slip. The solution is obtained in terms of the angle α, and from the resulting current-locus diagram each individual motor torque (and their difference) may be obtained *at that particular slip*. Complete torque performance can be examined by obtaining a number of solutions at various values of slip.

In Fig. 2 the arrows indicate positive direction of voltage, current and flux rotation (requiring mutually reversed rotor circuits); all secondary resistances and reactances are reduced to a 1 : 1 transformer ratio; and all circuit constants are "per phase."

E_S = line voltage, α = total rotor displacement angle in "electrical degrees," R_1 = primary winding resistance, S = fractional slip, $\frac{R_2}{S}$ = equivalent secondary winding resistance at slip S, $\frac{R_c}{S}$ = equivalent common secondary external resistance at slip S, jx_M = mutual reactance between stator and rotor, jx_1 = *total* primary reactance = mutual reactance + primary leakage reactance, jx_2 = *total* secondary reactance = mutual reactance + secondary leakage reactance, I_{S1}, I_{S2} = respective primary currents, I_{R1}, I_{R2} = respective secondary currents.

The conditions may now be stated by four simultaneous vector equations:—

$$E_S = \dot{I}_{S1}(R_1 + jX_1) + \dot{I}_{R1} jX_M \quad \ldots\ldots (1)$$

$$E_S = \dot{I}_{S2}(R_1 + jX_1) + \dot{I}_{R2} jX_M e^{-j\alpha} \ldots\ldots (2)$$

$$O = \dot{I}_{R1}\left(\frac{R_2}{S} + jX_2\right) + (\dot{I}_{R1} + \dot{I}_{R2})\frac{R_c}{S} + \dot{I}_{S1} jX_M \quad \ldots\ldots (3)$$

$$O = \dot{I}_{R2}\left(\frac{R_2}{S} + jX_2\right) + (\dot{I}_{R1} + \dot{I}_{R2})\frac{R_c}{S} + \dot{I}_{S2} jX_M e^{j\alpha} \ldots\ldots (4)$$

(Dotted terms indicate vector quantities.) These represent the general case within the limits of "equivalent circuit" representation, but their solution is somewhat cumbersome and for most purposes a simplified network (Fig. 3) may be used. This approximation accords generally with "equivalent circuit" technique where the respective internal resistances and leakage reactances are small compared with the mutual reactance.

In Fig. 3 all internal resistance and leakage reactance has been shifted to the secondary circuit, and:—

E_S = line voltage, E_{R1}, E_{R2} = total respective rotor voltages generated by air-gap flux, R_S = primary winding resistance, $\frac{R_r}{S}$ = equivalent secondary winding resistance at slip S, $\frac{R_c}{S}$ = equivalent common secondary external resistance at slip S, jX_m = mutual reactance, jX_T = mutual reactance + *total*

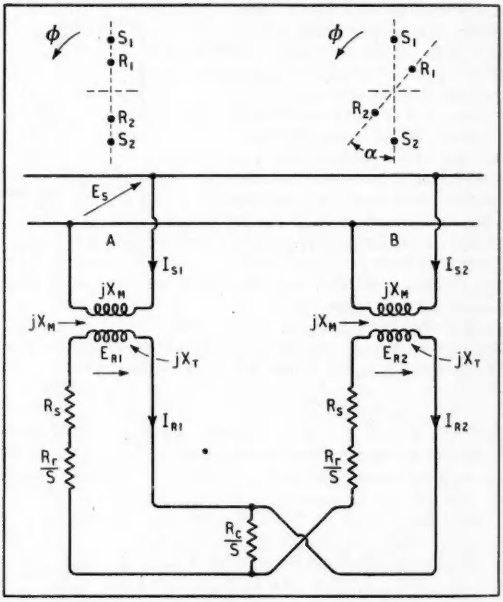


Fig. 3

leakage reactance, $jX\sigma$ = *total* motor leakage reactance = $jX_T - jX_M$.

The four equations now become:—

$$E_S = \dot{I}_{S1}\, jX_M + \dot{I}_{R1}\, jX_M \quad \ldots\ldots(5)$$

$$E_S = \dot{I}_{S2}\, jX_M + \dot{I}_{R2}\, jX_M\, e^{-j\alpha} \quad \ldots\ldots(6)$$

$$O = \dot{I}_{R1}\left(R_S + \frac{R_r}{S} + jX_T\right) + (\dot{I}_{R1} + \dot{I}_{R2})\frac{R_c}{S} + \dot{I}_{S1}\, jX_M \quad \ldots\ldots(7)$$

$$O = \dot{I}_{R2}\left(R_S + \frac{R_r}{S} + jX_T\right) + (\dot{I}_{R1} + \dot{I}_{R2})\frac{R_c}{S} + \dot{I}_{S2}\, jX_M\, e^{j\alpha} \quad \ldots\ldots(8)$$

Solving for I_{R1} and I_{R2}:—

$$\dot{I}_{R1} = E_S\left[\frac{e^{j\alpha}\frac{R_c}{S}}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2} - \frac{R_S + \frac{R_r + R_c}{S} + jX\sigma}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2}\right] \quad \ldots(9)$$

$$\dot{I}_{R2} = E_S\left[\frac{\frac{R_c}{S}}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2} - \frac{e^{j\alpha}\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2}\right] \quad \ldots(10)$$

Examination of the first term of equation (9) indicates that its locus as α varies from $0 \rightarrow 180$ deg is a semi-circle when S is constant (i.e., at a given slip). Since the second term of (9) is not a function of α, it has a positional effect only on the semi-circular locus. Equation (10) is similar. Furthermore when $\alpha = O$, $\dot{I}_{R1} = \dot{I}_{R2} =$

$$E_S\left[\frac{-1}{R_S + \frac{R_r + 2R_c}{S} + jX\sigma}\right] \quad \ldots\ldots(11)$$

and when $\alpha = 180$ deg,

$$\dot{I}_{R1} = E_S\left[\frac{-1}{R_S + \frac{R_r}{S} + jX\sigma}\right] \quad \ldots\ldots(12)$$

$$\dot{I}_{R2} = E_S\left[\frac{1}{R_S + \frac{R_r}{S} + jX\sigma}\right] \quad \ldots\ldots(13)$$

The current loci of I_{R1}, I_{R2} as defined by equations (9) and (10) when α varies from $0 \rightarrow 180$ deg, are shown in Fig. 4, where $PA = I_{R1}$ and I_{R2} when $\alpha = 0$; $PC_1 = I_{R1}$ when $\alpha = 180$ deg; $PC_2 = I_{R2}$ when $\alpha = 180$ deg; and $PC_1 = -PC_2$.

The current vectors of I_{R1} and I_{R2} may be drawn for any value of α between 0 and 180 deg by setting the angle α from P_1A and P_2A respectively round the respective semi-circles about their centres P_1 and P_2.

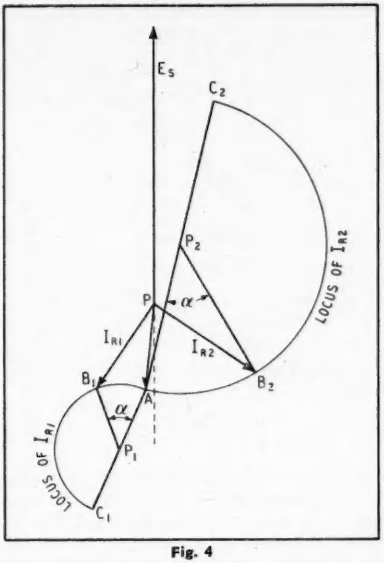


Fig. 4

Fig. 4 represents the time-phase of I_{R1} and I_{R2} with respect to E_S. To find the torque of each motor at any value of α, it is more convenient to define the rotor currents with respect to the total induced rotor voltages E_{R1} and E_{R2}. The torques may then be measured by the rotor "synchronous watts" in each case, since $E_{R1} = -E_S$ and $E_{R2} = -E_S\, e^{j\alpha}$.

Equations (9) and (10) may now be written:—

$$\dot{I}_{R1} = E_{R1}\left[\frac{R_S + \frac{R_r + R_c}{S} + jX\sigma}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2} - \frac{e^{j\alpha}\frac{R_c}{S}}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2}\right] \quad \ldots(14)$$

$$\dot{I}_{R2} = E_{R2}\left[\frac{R_S + \frac{R_r + R_c}{S} + jX\sigma}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2} - \frac{e^{-j\alpha}\frac{R_c}{S}}{\left(R_S + \frac{R_r + R_c}{S} + jX\sigma\right)^2 - \left(\frac{R_c}{S}\right)^2}\right] \quad \ldots(15)$$

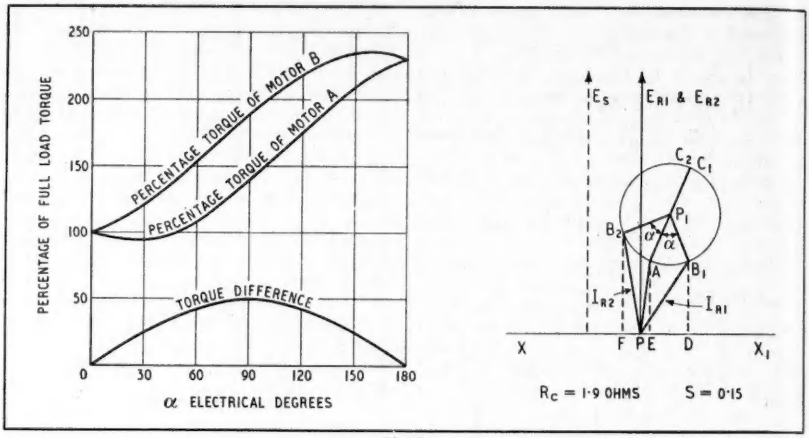


Fig. 5

Equations (14) and (15) may be represented by the current loci shown in Fig. 5, where the rotor voltage vectors E_{R1} and E_{R2} are shown in phase coincidence, in which case the loci of I_{R1} and I_{R2} are halves of the same circle. To obtain the rotor synchronous watts and thus the torque of each motor at any angle α it is only necessary to set the angle α in each semi-circle from P_1A about the centre P_1. I_{R1} and I_{R2} for the total angular displacement α are represented by PB_1 and PB_2 respectively. The synchronous watts are obtained from the rotor wattful currents B_1D and B_2F which are drawn perpendicular to XX_1. E.g.:—

$R_S = 1{\cdot}6$ ohms; $X\sigma = 5$ ohms; $R_r = 2{\cdot}3$ ohms; $E_S = 230$; R_C = the resistance required to give 15 per cent slip when both motors are developing full load torque (i.e., $\alpha = 0$); $R_C = 1{\cdot}9$ ohms, and $S = 0{\cdot}15$.

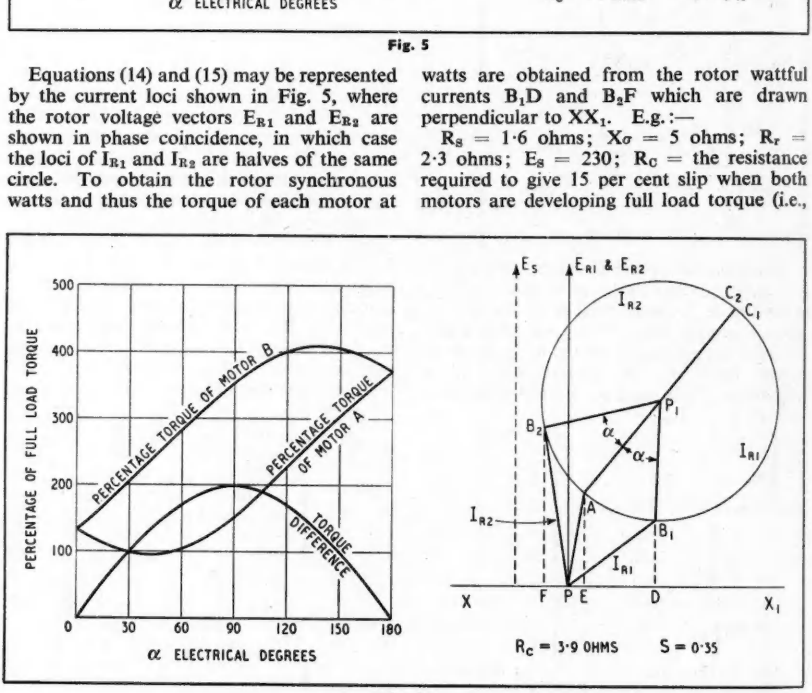


Fig. 6

From equations (14) and (15):—

$$I_{R1} = (8{\cdot}95 - j\,2{\cdot}14) - e^{j\alpha}(3{\cdot}58 - j\,1{\cdot}53)$$

$$I_{R2} = (8{\cdot}95 - j\,2{\cdot}14) - e^{-j\alpha}(3{\cdot}58 - 1{\cdot}53)$$

The torque of each motor is shown in Fig. 5, also the difference in torque, all as a function of the angle α. This difference provides the "tie" and is proportional to sine α. The maximum synchronizing torque therefore occurs at $\alpha = 90$ deg for any given value of slip, any increase in angle above 90 deg resulting in a decreasing torque with consequent instability.

Fig. 6 gives curves and locus diagram, $R_S = 1{\cdot}6$ ohms; $X\sigma = 5$ ohms; $R_r = 2{\cdot}3$ ohms; $E_S = 230$; $R_C = 3{\cdot}9$ ohms and $S = 0{\cdot}35$. R_C has been chosen to give 35 per cent slip when both motors are developing 135 per cent of full load torque (i.e., $\alpha = 0$).

A common alternative arrangement to provide synchronous tie is shown in Fig. 7. A and B are the main driving devices (not necessarily motors), A_1 and B_1 being the synchronizing motors driven by A and B. Fig. 8 represents the simplified equivalent circuits (as used in Fig. 3) of A_1, B_1 as connected in Fig. 7. There is no common rotor external resistor, and current flows in the rotors only when a difference of torque between the main motors A and B produces a torque angle between the synchronizing motors A_1 and B_1.

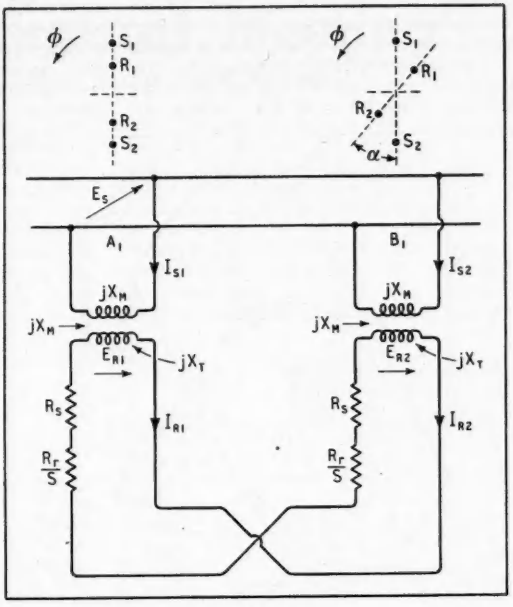


Fig. 8

Conditions in the machines A_1 and B_1 at a particular common value of S in accordance with the network shown in Fig. 8 may be stated:—

$$E_S = \dot{I}_{S1}\, jX_M + \dot{I}_{R1}\, jX_M \quad \ldots\ldots (16)$$

$$E_S = \dot{I}_{S2}\, jX_M + \dot{I}_{R2}\, jX_M\, e^{-j\alpha} \quad \ldots\ldots (17)$$

$$O = \dot{I}_{R1}\left(\frac{R_r}{S} + R_S + jX_T\right) + \dot{I}_{S1} jX_M - \dot{I}_{R2}\left(\frac{R_r}{S} + R_S + jX_T\right) - \dot{I}_{S2}\, jX_M\, e^{j\alpha} \quad \ldots\ldots (18)$$

$$\dot{I}_{R1} = -\dot{I}_{R2} \quad \ldots\ldots (19)$$

Their solution when $X\sigma = X_T - X_M$, $E_{R1} = -E_S$ and $E_{R2} = -E_S\, e^{j\alpha}$ gives:—

$$\dot{I}_{R1} = E_{R1}\left[\frac{1}{2\left(\frac{R_r}{S} + R_S + jX\sigma\right)} - \frac{e^{j\alpha}}{2\left(\frac{R_r}{S} + R_S + jX\sigma\right)}\right] \quad \ldots\ldots (20)$$

$$\dot{I}_{R2} = E_{R2}\left[\frac{1}{\left(\frac{R_r}{S} + R_S + jX\sigma\right)} - \frac{e^{-j\alpha}}{2\left(\frac{R_r}{S} + R_S + jX\sigma\right)}\right] \quad \ldots\ldots (21)$$

The loci of I_{R1} and I_{R2} respectively are halves of the same circle when defined with respect to E_{R1} and E_{R2} drawn in phase coincidence in Fig. 9. Rotor

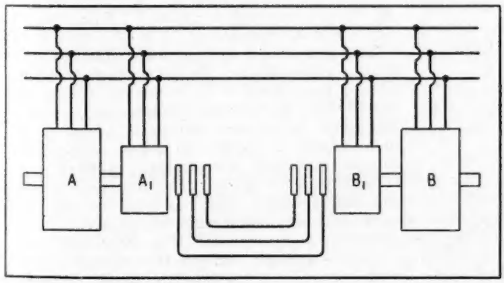


Fig. 7

currents, " synchronous watts " and torques may again be obtained for any total displacement angle α by setting the angle α in each semi-circle from P_1C about the centre P_1. I_{R1} and I_{R2} for a total angular displacement α are represented by PA_1 and PA_2 respectively.

value of S it provides synchronizing rotor voltage down to zero speed without that voltage passing through zero. A value of S = 1·0 is only possible at standstill. Approximate investigation of the current and torque conditions at a number of values of S will

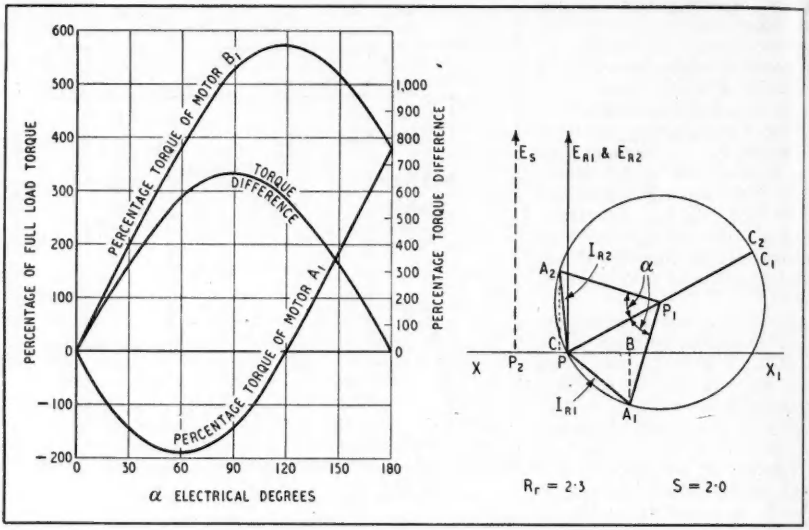


Fig. 9

The synchronous watts are obtained from the rotor wattful currents A_2C and A_1B which are drawn perpendicularly to XX_1. The vectors of I_{R1} and I_{R2} for any value of α must always be equal in scalar value, since $I_{R1} = -I_{R2}$ when they are defined with respect to the true phase position of E_{R1} and E_{R2}. However, their loci in Fig. 9 represent the true phase position of I_{R1} and I_{R2} when referred to their primaries. Furthermore the circle now defines the locus of stator currents if their vectors are drawn from the shifted origin P_2, where PP_2 represents the magnetizing current.

E.g.:—$R_s = 1{\cdot}6$, $R_r = 2{\cdot}3$, $X\sigma = 5$, $E_s = 230$ and $S = 2{\cdot}0$. From equations (19) and (20),

$$I_{R1} = (9{\cdot}75 - j\,17{\cdot}7) - e^{j\alpha}(9{\cdot}75 - j\,17{\cdot}7).$$

$$I_{R2} = (9{\cdot}75 - j\,17{\cdot}7) - e^{-j\alpha}(9{\cdot}75 - j\,17{\cdot}7).$$

When $\alpha = 0$ $I_{R1} = I_{R2} = 0$.

When $\alpha = 180$ $I_{R1} = I_{R2} = 19{\cdot}5 - j\,35{\cdot}4$.

The slip is not restricted to S = 2·0 (obtained by driving the rotors of A_1, B_1 against their stator fields), but with a positive

often suffice. If, however, a complete analysis is desired including power flow conditions on the more accurate basis of Fig. 2, the equations (16), (17) and (18) may be easily modified and solved to produce locus diagrams. The author's thanks are due to Bull Motors (branch of E. R. & F. Turner, Ipswich) for permission to publish this article.

Resistance Materials Handbook

A NEW publication entitled " The Wiggin Electrical Handbook " is now available on request from Henry Wiggin & Co., Ltd., Wiggin Street, Birmingham, 16. Its purpose is to replace the company's " Electrical Resistance Materials." In addition to data on resistance materials, useful information is included on such subjects as nickel-iron alloys, temperature control materials, thermostatic bimetals and high temperature alloys. The list of conversions and mathematical data has been revised and extended and current carrying capacity is presented as a nomogram. The loose leaf form has been retained, because it is hoped to add fresh or revised information as it becomes available.

I.E.E. Inaugural Meeting

MR. HALDANE'S ADDRESS: KELVIN MEDAL PRESENTED

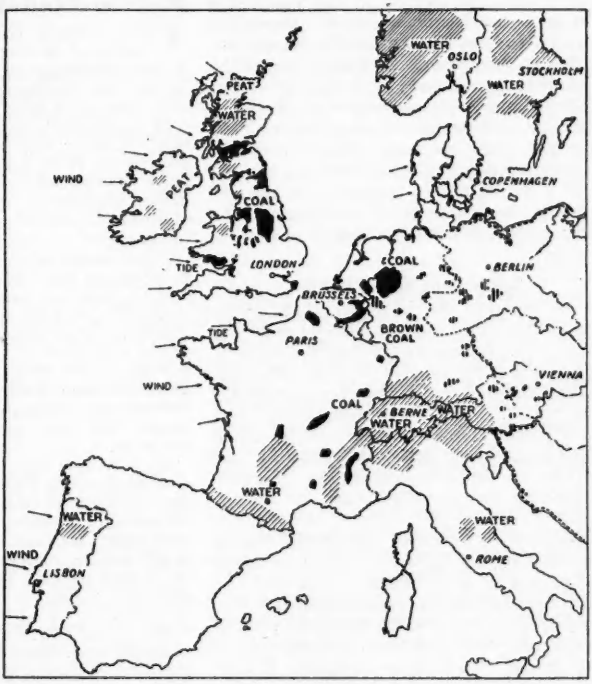
In his inaugural address as president of the Institution of Electrical Engineers for 1948-49, Mr. T. G. N. Haldane first summarized technical developments that affect material well-being. These, he pointed out, were but a prerequisite for fundamental human developments and the discussion of the philosophic outlook necessary for this formed the second part of the address.

After mentioning the loyal acceptance of the new organization of electricity supply, he referred to the need for co-operation by the British Electricity Authority with manufacturers to ensure that plant made for home use would be suitable for export and to provide opportunities for gaining experience in the design and operation of improved means of generation and high-voltage transmission for the same purpose. This experience also aided consulting engineers, who exported services that were not offset by imports of raw materials.

Increased mechanization was essential to reconstruction of Europe. Although in Great Britain the main source of energy must continue to be coal (with transport distances minimized), capacity to meet peak loads could be improved by such means as water-power plant operating at low load factors (or perhaps in conjunction with pumped storage) and gas turbines, burning oil, for load factors at present economically limited to 10 to 15 per cent. Run-of-the-river and tidal schemes without storage and wind power on the west coast could, because of grid interconnection, supply kWh intermittently but not firm kW. Nuclear fission, if and when used for power production, would perhaps be developed only on a large scale and in remote districts at a high load factor.

Transmission at 275 kV (the highest voltage for which cables could at present be made) had been envisaged as a national busbar to be superimposed on the 132-kV grid. This would affect the choice of power station sites, which when all those available at estuaries had been taken up, would most economically be near coal fields, possibly associated with gas turbines at load centres to deal with peaks.

The use of 275 kV would facilitate the



Energy resources of Europe

operation of the most economical generating plant at the highest load factors. Probably 10 per cent of the £65 million spent on coal in 1947 could thereby be saved, apart from savings due to the higher efficiencies of future plant.

Advances in transmission technique indicated the possibility of extending interconnection of the high-voltage systems of Western European countries in order to make better use of their energy resources. Lines going eventually from Scandinavia to France, Austria, Switzerland and Italy were envisaged. At first such interconnection would be confined to the improved use of existing resources, leaving most countries with approximately enough plant to meet their own internal requirements. The load round London was nearer to some Continental power resources than to British, and modern high-voltage cables could be laid across the Channel and thence to Paris for about £15 million. Water power, from which the Western Continental countries derived two-thirds of their total energy, was in excess at certain seasons and could be used here in return for electricity generated in thermal stations when water was short. There would also be diversity due to differences in weather and time.

Science and Human Needs

Turning from material aspects of life, which were being increasingly recognized as inadequate, Mr. Haldane emphasized the value of cultivating a philosophic outlook especially among students during the character-formation period. None were engineers only and ideas pushed into the background governed behaviour. Engineers were concerned not only with the advancement of scientific knowledge but its application to human needs.

With the growth of knowledge came the need for specialization which hindered the acquisition of a broad outlook and the Institution had therefore consistently opposed early specialization, which led a majority to concentrate on mastering the means of life and remain oblivious to its ends. Higher education of engineers in universities rather than in mono-technic colleges was to be preferred because of the opportunities thus provided for mixing with students concerned with other branches of knowledge, including the humanities. More time should be given to the study of scientific thought and engineering achievement.

Science seemed unlikely to extricate the world from its present condition and its methods were no longer regarded as applicable to the conduct of human affairs; they could only increase the precision of its findings within a limited but important field, such as in the disinterested search for truth.

The faith of an engineer in his calling was founded on his ability to create the material conditions necessary for spiritual development and on the nature of his work, which developed important non-material values. Applied science was not and could not be an end in itself and civilization would be imperilled if the means were confused with the end.

Kelvin Medal Presentation

THERE was a crowded gathering at the inaugural meeting of the 1948-49 session of the Institution of Electrical Engineers in London on 7th October. Mr. P. Good presided and called upon Sir Roger Hetherington (retiring president, Institution of Civil Engineers) who explained that the Kelvin Medal, first awarded in 1920, is presented triennially as a mark of distinction in engineering work or investigation (rather than in physical science) of kinds with which Lord Kelvin was especially identified.

The Awards Committee consists of the presidents of eight institutions in this country and it receives nominations from leading engineering societies in all parts of the world, eligibility being irrespective of nationality.

The Institution of Civil Engineers acted as convener of the Committee for the 1947 award which has been made to Air Commodore Sir Frank Whittle, K.B.E., C.B., M.A., F.R.S., and the presentation was performed by Sir John Anderson.

It was singularly appropriate that the ceremony should take place last week while representatives of certain overseas institutions, which had themselves been invited to submit nominations, were in London for the Conference of Engineering Societies of Western Europe and the United States. They were thus enabled, with their ladies, to witness the presentation ceremony.

Afterwards Mr. Percy Good formally welcomed new corporate members of the I.E.E. and then presented premium certificates to winning authors of papers read last session.

After Mr. T. Graeme N. Haldane had delivered his presidential address, he presented a certificate of presidency to Mr. P. Good upon his retirement from the chair.

Mr. Harold Bishop, C.B.E., B.SC. (B.B.C.) who has previously served as an ordinary member of the Council and as chairman of the Radio Section, has been elected a vice-president in place of the late Mr. D. B. Hoseason.

Views on the News

By REFLECTOR

THE plea made by Sir Frank Whittle in returning thanks for the Kelvin Medal at the Institution of Electrical Engineers last week, that the engineering outlook based on cause and effect could well be adopted in other fields, seemed to me complementary to the thesis subsequently advanced in the presidential address. The latter was concerned with what an engineer has to gain by cultivating a philosophic outlook that would enable him to "escape a little from the domination of the 'here and now.'" Two-way traffic of this kind would benefit everybody.

✦ ✦ ✦

The re-arrangement of office accommodation which has been going on at the I.E.E. headquarters in London has involved the re-lighting of certain parts of the building and, not unexpectedly, some fluorescent lighting has been introduced. There are doubtless people who do really like this fashionable form of artificial illumination and I am aware that true colour rendering is of little consequence in many situations. I am, however, very sorry to notice that members can no longer enjoy the coloured ceiling decorations in the lecture theatre. The portraits in oil which hang on the mahogany panelling will need further contemplation, but previous experience of an office similarly panelled and lighted has not impressed me.

✦ ✦ ✦

I do not like the spirit that is getting abroad as a result of the power shortage. A feeling is being engendered that may do permanent harm to the industry. The sort of thing I mean is exemplified by a statement made by a speaker at a "peak-cutting" meeting attended by representatives of local authorities, Chambers of Commerce and trade unions in the West of England recently. This speaker said that the Government might have called a halt to the production of electric cookers, heaters, electric refrigerators, etc. "These appliances have been turned out in thousands apparently with little regard to whether there would be enough current for them." The implication is that no new domestic electrical appliances should be allowed for an indefinite period because they all add to the peak load. With the possible exception of heaters this is not strictly true and people should not be denied the undoubted convenience of these appliances on such an assumption.

✦ ✦ ✦

A contributor to the *Gas Times* signing himself "Argus" makes a similar suggestion. He begins by approaching the matter from a different direction—coal economy—but after claiming that gas is much more efficient for space heating and water heating he goes on to contend that with the power plant situation as it is not another electric cooker should be sold and any replacements should be carried out with gas cookers where gas is available and no more electric space heaters should be sold. He has the nerve to assert that "electricity for domestic use must be viewed as a luxury and there seems to be no other alternative but to raise its tariff into the luxury class and reduce the tariff on gas for space-heating and water-heating to an appreciable extent." If he really sees things this way "Argus" should consult a multi-oculist.

✦ ✦ ✦

Quite a number of people will not have to pay the 0·35d. per kWh surcharge upon their electricity this winter. Nor, on the other hand will they receive the summer rebate. These are the prepayment meter consumers. It is impossible to adjust their meters to the new rates and it would be equally impossible to levy an extra charge when the meters were read—and so they are to be left alone.

✦ ✦ ✦

Edinburgh Castle is floodlighted on every possible occasion. Last week a visit of the delegates to the Commonwealth Parliamentary Conference provided the excuse. The Conference was in London but London's public buildings remained in darkness. This is another injustice to England.

✦ ✦ ✦

I have just been told that for some time past a subscriber to the *Electrical Review* in Malaya has had his copy sent regularly by air mail. This may not seem very wonderful nowadays, but I am also told that on account of the weight the cost is twelve or thirteen shillings a week. This, I consider, indicates a remarkable appreciation of the value of this journal.

New Zealand's Power Position

PROGRESS OF NEW WORKS

ABNORMALLY dry weather again seriously affected the operations of the New Zealand State Hydro-electric Department last year and during twelve weeks of emergency restrictions the generation of electricity was drastically reduced. Nevertheless, work on new schemes was advanced to such an extent that the overall power position was materially improved in both Islands.

In the North Island the main projects are a group of stations along the Waikato River, flowing from Lake Taupo in the centre of the Island; and the Lake Waikaremoana scheme to the east towards Hawke's Bay. At Karapiro on the Waikato the final set was placed in commission last June, the plant comprising three 42,000-h.p. Boving Kaplan type turbines driving 30,000-kW Metropolitan - Vickers alternators. The dam, which is 100 ft high and 576 ft long, forms a lake which has submerged the former Horahora station. Upstream from Karapiro after passing the existing Arapuni station (145,000 kW) sites for new plants are at Waipapa (50,000 kW); Maraetai (180,000 kW), where it is hoped to have the first unit in commission early in 1951; Whakamaru (100,000 kW); Atiamuri (50,000 kW); Ohakuri (100,000 kW); Parariki (20,000 kW); Aratiatia (60,000 kW); Huka Falls (40,000 kW).

The first 16,000-kW unit at Kaitawa (Waikaremoana scheme) was brought into temporary operation last April and a second unit was expected to be available in July. Twin tunnels have been driven down to the power station through the thin lake rim and the difficult work of sealing the flow through the natural barrier is not expected to be completed before the end of next year.

Clutha River Development

In the South Island, projects include the Waitaki, Clutha River and Cobb River undertakings. At Waitaki it is hoped that the fifth 15,000-kW unit will be in operation by the end of 1948, and a 25,000-kW set at Tekapo should be ready by the end of 1950. On the Cobb River, installation of two 10,000-kW units now on order is not expected to be completed before the end of 1951. The very large development on the Clutha River above Roxburgh has been the subject of comprehensive study. Control of the outflow of Lakes Wakatipu, Wanaka and Hawea will be essential for this 320,000-kW scheme and it is unlikely that initial operation of the plant can start before 1955. Surveys have also been carried out at Lakes Rotoito and Rotoroa preparatory to a major development, and reconnaissance proceeded in the southern sounds in conjunction with an overseas company interested in the manufacture of aluminium.

In the North Island 1,778 million kWh was generated during 1947-48 compared with 1,718 million kWh in the previous year, an increase of 3·5 per cent, the maximum half-hourly demand on the system being 343,000 kW (against 314,800 kW). In the South Island there was a fall in production, due to rationing, from 753 million to 748 million kWh, but the system maximum demand was 4·4 per cent higher at 160,700 kW.

The Rural Electrical Reticulation Council reports that under the Electricity Act, 1945, the Council has provisionally approved the payment of subsidies on 893 miles of line, but so far only 77 miles have been built, difficulty having been experienced in obtaining the necessary line materials. It is hoped that the work will be speeded up this year.

A summary of the financial results of the State Hydro-Electric Department shows that revenue amounted to £3,258,647, with operating costs of £1,459,321. After meeting interest and depreciation charges there was a balance of £464,045. Of this, income and social security taxes absorb £165,760 and £106,609 is deducted for net accumulated losses, leaving £191,676 to meet the year's loan redemption charge of £517,533, thus increasing arrears to £1,166,533.

Electricity from Natural Steam

Mr. F. T. M. Kissel retired from the position of general manager of the Department at the close of the year under review and the report is presented by his successor, Mr. A. E. Davenport. In a statement accompanying the report the Hon. R. Semple, Minister in charge of the Department, reiterates the view that the country's power requirements for at least another decade can best be met by the development of its major hydro-electric resources. With regard to the possible use of geo-thermal steam which is being investigated by the Department of Scientific and Industrial Research, this alternative is attractive if economically and technically feasible.

Mechanical Power Transmission

THE seventh edition of the directory of mechanical power transmission equipment published at 6s. by the Trade & Technical Press, Ltd., 65, Chancery Lane, London, W.C.2, has been re-set and enlarged. In Sec. 1 some 1,400 trade and brand names are listed alphabetically with their owners' names and addresses. Sec. 2 is a classified list of products and Sec. 3 is a list of manufacturers and suppliers while Sec. 4 is a newly added geographical directory of suppliers.

Correspondence

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Portable Electric Tools

FURTHER to my letter published in your issue of 1st October and Mr. Milne's letter in last week's *Electrical Review*, I would like to clarify my point that large trade users such as car and aircraft manufacturers should be given a discount on portable electric tools.

I gave as an example a "back street" ironmonger who would enjoy 20 per cent discount although his sale of this class of tool might be only equal in twelve months to one individual order from a car or aircraft factory. During the war my company purchased on an average some 250 tools per annum. On drills we had a discount of 20 per cent and on tool grinders 15 per cent. The cutting out of these discounts by the manufacturers' association is the reason for my protest.

With regard to wholesalers, I would state that over a very long period I have found them very helpful; they have repeatedly gone to considerable trouble to give me service. On the other hand, during the last few weeks I have been offered new and second-hand diesel alternator sets by an agent. The second-hand set was offered by the owners at some £550 less than the agent's price. For the new set the agent's price was £1,150 more than the manufacturer's quotation and did not include switchgear. I leave you to draw your own conclusion.

Yeovil. W. J. BENNETT, A.M.I.E.E.

Wholesalers and the Public

IT was stated by "Reflector" in your issue 17th September that an allegation has been made by the Derby Branch of the E.C.A. that some wholesalers are making cash transactions at their trade counters with all and sundry and are giving advice on wiring matters.

If not challenged, a general statement of this kind might have an adverse effect on the business of *bona fide* wholesalers. If the position is as stated, I should appreciate evidence of these misdemeanours.

I will not question the right of a wholesaler to advise a contractor on wiring matters, but I do question any statement that this could be regarded as a menace, as I can assure you that many wholesalers are fully qualified to give advice when sought.

London, W.C.2. A. B. WILDSMITH, *Director*, Electrical Wholesalers Federation.

["Reflector" points out that the "menace" to which he referred was the giving of advice to the public, not to contractors.—EDITORS, *Electrical Review*.]

Impregnating Plant

I HAVE read "P.H.'s" letter in your issue of 1st October with interest. I am sorry that he should think I would not concede that there would be certain types of components which might require vacuum impregnation to produce satisfactory results. Indeed, I went to some lengths in my letter of 10th September to make it clear that my comments were based on the statement in the original article which referred to "armatures, coils, transformers, etc." in general terms, and that no special types of "armatures, coils, etc.", had been mentioned. I intended this to indicate that I would agree that there were special types of component where vacuum impregnation might be necessary. I do feel, however, that this group forms but a small proportion of the total of electrical components requiring impregnation.

"P.H." refers to the possible difficulty of getting good impregnation by hot dipping with a varnish having a high solid content. This, I agree, may be true, but I would point out that the "solid content" of a varnish is by no means the sole criterion of its penetrating qualities; one can have two varnishes, each having the same solid content, and one will have excellent penetrating properties, and the other the reverse. There is available at present a solventless varnish which has quite remarkable penetrating qualities when "hot dipped."

I am not too clear as to what type of component is referred to under the heading of "multiform range" where the efficacy of non-vacuum impregnation is doubtful. I would suggest there should be no doubtful process; if one method will not produce good results, then the other should be used.

In this matter of impregnation it is my

opinion that the actual varnish is far more important than the method used. On its ability to stand up to specified working conditions will depend the life of the impregnated component. No method of impregnation can make a good varnish from an inferior one, and an excellent "impregnation" with an unsuitable varnish, can be a snare and a delusion.

Brighton. L. E. S.

Domestic Tariff Charges

I AM rather surprised at the negative attitude taken by the Electrical Press towards the recommendations of a seasonal variation in the "unit" charge of domestic tariffs.

Has it been forgotten that prior to the war this principle was advocated by prominent members of the industry, and adopted by quite a number of undertakings, e.g., the London and Home Counties J.E.A. ? Only, the increased charges were operative during two quarters, whereas the Clow Report confines them to one. Although it does not state so, I suppose the idea behind this was that the differential could thus be made twice as high, and so be of greater effect during the most critical months.

Taking the figures now published, an increase of 0·35d. per kWh during three winter months is accompanied by a reduction of 0·1d. per kWh during the rest of the year, the differential being 0·45d. per kWh. In the instance mentioned above, it used to be 0·275d. per kWh. Supposing the monthly consumption for cooking purposes to be approximately constant throughout the year, this application will be hardly affected. Water heating confined to the warmer season will benefit by 0·1d. per kWh. It is only a clearly seasonal portion of space heating that will really be hit, and that seems to be desirable in present circumstances.

The only snag is that the object is partly defeated by the continuous meter reading in operation in many areas. However, it should be possible to compress these quarterly readings into one month, though with an increase of staff. This would then be sufficient for a permanent change-over to monthly readings.

In view of the steadily rising consumption of electricity and the still greater rate of rise of quarterly bills, it seems that serious consideration should be given to the general introduction of monthly readings and billing (excepting, perhaps, scattered rural consumers), as practised in most countries abroad, including United States. It would, of course, also involve an increase of accounting staff and machines, but might make it possible to do away with prepayment meters, which by many in the industry are regarded as an expensive nuisance.

"ELECTRICUS."

Shop Load Limitation

I HAVE read with interest the Clow Report on the various steps to be taken to limit the electricity supply load taken by domestic and commercial premises, and have read with equal interest the many comments appearing in the electrical and even daily papers.

Last March, in conversation with a member of the Committee, I suggested that one method of limiting the commercial load during peak hours was either to induce or coerce a considerable proportion of retail shops not to open until 10 a.m. and then to keep open continuously until 4 p.m. in the three winter months. I have since spoken with several chairmen and members of Chambers of Commerce, and while I fully realize that it is impossible for all shops to open only during the above-mentioned hours, yet I am still of the opinion that a sufficient number of them could be made to remain closed before 10 a.m. and to close at 4 p.m. I have been told by several traders that all they can get to sell can easily be sold in these six hours.

I presume this suggestion was considered by the Committee, but whether or not, my own opinion still is that a worth-while result would have been obtained in limiting the demand of commercial premises over early morning peak as well as late afternoon peak. In addition, no alterations to charges would be required with all their attendant book-keeping troubles and no new instruments of any sort would be necessary.

I know some of the objections that have been raised to this idea, particularly about the unfairness to shops that are shut. This, I consider, could easily be overcome by making shops close in alternate weeks.

Maidstone. E. E. HOADLEY.

Double Bathroom Fatality.—A seventeen-year-old domestic servant, Christine Mitchell, and an infant girl were found dead in the bathroom of a house at Wheatley Hill, Co. Durham, on Monday. The maid was holding an electric kettle and it is believed that electric shock caused both deaths.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Leon Gaster Memorial Premium, consisting of ten guineas and a certificate, given annually by the Illuminating Engineering Society for the best contribution submitted to and published by the Society during the session, is this year awarded by the Council of the Society to **Messrs. J. N. Bowtell** and **H. G. Jenkins** for their paper entitled "High Voltage Fluorescent Tubes." In view of the high standard of papers eligible for the award this year, the Council has decided to make a second award to **Messrs. H. K. Cameron, E. H. Rayner, E. R. Thomas** and **G. T. Winch** for their paper entitled "Photometry of Searchlights" which forms part of the "Symposium on Searchlights" which has recently been published by the Illuminating Engineering Society.

Mr. H. B. T. Wilde, F.C.A., has been appointed deputy chairman of Veritys, Ltd., and **Mr. R. S. Blackledge,** M.I.E.E., M.I.MAR.E. (chief designer) has been elected a director of the company.

In appreciation of twenty-eight years' continuous service as chairman of the Lancashire Electric Power Co.'s Mains Department Works Committee, **Mr. R. C. Leslie,** who is now manager of the No. 2 (Bolton) Sub-Area of the North Western Electricity Board, has been presented with a writing outfit and brochure, subscribed for by members of the Works Committee and the manual employees of the Mains Department. The presentation was made by Mr. S. D. Larcombe, A.M.I.E.E., mains engineer, No. 2 (Bolton) Sub-Area, at Hilton House, Westhoughton, on 18th September, in the presence of members of the Committee and chief officers of the Sub-Area.

Mr. H. Tilsley has been appointed assistant sales manager (export) with the British Aluminium Co., Ltd., as from 1st October. **Mr. W. H. Marston** is relinquishing his position as manager of the company's Leeds branch office at his own request and will be transferred to the London branch office as from 1st November. **Mr. A. E. Heeley** has been appointed manager of the company's Leeds branch office as from 1st November.

On relinquishing the post of works manager of the switchgear and instrument works, **Mr. A. H. Wroe** has been presented with a number of gifts from various sections of the English Electric Co., Ltd., Trafford. Mr. Wroe has been with the company for fourteen years, prior to which he was connected with the engineering industry in the United States.

The first social function of the recently-formed Midlands Branch of the **Electrical Trades' Commercial Travellers' Association** held last week took the form of a dinner and concert at the Market Hotel, Birmingham. Mr. J. D. Nicholls presided and officials of the Association from London and Midlands Electricity Board representatives were present. Mr. R. K. Cox said that the Association was formed in London in 1925 and had raised more than £6,000 for the Royal Commercial Travellers' School and the Electrical Industries' Benevolent Fund. The local branch looked forward to a considerable increase in membership. Alderman W. T. Lewis, chairman of the Midlands Electricity Board, said that the Board's motto was to give service to the consumer. There was no wish to operate against electrical manufacturers, but with their co-operation in giving the Board the right quality products and good service in the future as they had in the past, the Board hoped to achieve its objective.

Thos. W. Ward, Ltd., have appointed **Messrs. C. Parry, D. F. Walton, W. Hall** and **H. H. Mumby** as additional local directors of the company.

The **Johnson Matthey Amateur Dramatic Society** is presenting its sixth post-war play "George and Margaret," a comedy by Gerald Savory, on 26th and 27th November next at King George's Hall, Adeline Place, London, W.C.1. The box office telephone number is Holborn 6989.

The final of the **Electrical Industries National Golf Championship** took place at Moor Park Golf Club on 8th October. In the morning forty-one competed for the Sir Montague Hughman silver-gilt championship trophy. A two-ball foursomes competition was played in the afternoon. In the competition for the Sir John Dalton silver tankard and replica Mr. W. Murfin was first, Mr. F. W. Dewhurst (Manchester Area) was runner-up; and Mr. L. R. John (Northern Area) won the best scratch score trophy with 81. The foursomes competition was won by Messrs. L. W. Bryan and A. G. Mackerrell, and R. M. Smart and R. A. Clarke, both pairs receiving Sir Felix Pole's twin trophies. The referee for the championship, Mr. J. A. Dixon, playing in the guests' match, narrowly beat Mr. P. V. Hunter.

Sir Montague Hughman (Henley's) presented the trophies and awards and expressed pleasure in being able to hand the championship trophy award to a member of his own organization. He thanked the hon. secretary, Mr. A. Hughes (British Insulated Callender's Cables, Ltd.) and Mr. W. D. Taylor (Metropolitan-Vickers) for their work on behalf of the E.I.B.A.

A dinner was held at the club house after the presentations. Mr. A. B. Wildsmith apologized for the absence of the E.I.B.A. president and secretary. Mr. A. Hughes said that about £500 net had been raised for the E.I.B.A. from the series of competitions.

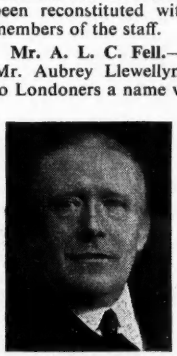
Obituary

Sir Arthur Whitten-Brown, K.B.E., M.I.E.E., who died on 4th October and who, with the late Sir John Alcock, was the first to fly the Atlantic, was manager of the Swansea office of the Metropolitan-Vickers Electrical Co. He was one of the earliest Westinghouse apprentices, starting at Trafford Park in 1902 at the age of sixteen. He later joined the Control Department and then transferred to the Electric Plant Department where he was responsible for the design of a number of pioneer colliery winding installations.

During the 1914-18 war he served with the R.F.C. His historic flight was made on 14th June, 1919, and both he and Alcock were knighted. After a period as a foreign representative of the Vickers Aviation Co., he returned to the Metropolitan-Vickers organization and was appointed manager at Swansea in 1923.

Mr. J. W. Thornton.—The death occurred on 28th September of Mr. J. Wemyss Thornton, managing director of Robert Crawford & Co., Ltd., insurance brokers with many electrical connections. The board of the company has been reconstituted with the addition of four members of the staff.

Mr. A. L. C. Fell.—The death last week of Mr. Aubrey Llewellyn Coventry Fell recalled to Londoners a name which for some years was prominently displayed on the vehicles of the L.C.C. Tramways, of which Mr. Fell was general manager from 1933 to 1924. Mr. Fell, who was born in 1869, was educated at Christ's College, Finchley, and the School of Electrical Engineering, Hanover Square, London. In the earlier part of his career he was with the British Thomson-Houston Co., Ltd., superintending tramway equipment at Croydon, Cork and Sheffield. He then joined the Sheffield Corporation Tramways in 1897 as electrical engineer, becoming engineer and manager in 1900. During his period with the L.C.C. Mr. Fell was responsible for building up one of the largest systems of its kind in the world and on his retirement through ill-health, at the early age of fifty-five, his services were recognized by a special pension arrangement.



The late Mr. A. L. C. Fell

Mr. Fell had been a member of the Institution of Electrical Engineers since 1897 and was awarded the C.B.E. in 1920.

Mr. J. S. Dow.—A memorial service to the late Mr. John Stewart Dow, who was closely associated with the Illuminating Engineering Society from its foundation in 1909 until his death on 12th August, will be held at the King's Chapel of the Savoy, Savoy Street, London, W.C.2, at 12 noon on Tuesday, 19th October.

Mr. Maxwell Smith.—The death occurred on 26th September last at Beeston, Notts, at the age of fifty-eight of Mr. Maxwell Smith, M.B.E., M.I.E.E., of the Engineering Department of Ericsson Telephones, Ltd. Mr. Smith joined Ericsson's in 1914, after service with the Western Electric Co., Woolwich, and in 1920 took up an appointment with the Oriental Telephone Co. as assistant manager in Singapore. He returned to the Ericsson Co. in 1924 and during the war he was regional adviser to the Ministry of Labour in connection with the Technical and Scientific Register.

The late Mr. Maxwell Smith

Lighting Problems

THE presidential address of Mr. J. M. Waldram (G.E.C.) to the Illuminating Engineering Society commenced with the observation that advances recently made were all mainly concerned with sources of light. In illuminating engineering proper, in the sense of controlling light, there had been few conquests because there were few worlds left to conquer.

Available means were well known; illuminating engineers needed most to know what they wished to do, for "seeing" was more than "sight" and it was becoming necessary somehow to penetrate into the region of unmeasurable sensation.

He doubted if information on threshold performance, invaluable as it was for some purposes, was valid for most problems of lighting. There was a great range of lighting problems in interiors in which there was no very definite task and in which the engineer was at a loss. The problem at the centre of the "picture" was æsthetic; there, away from the thresholds, the scientist was still blind, but the artist could see and he would have to lead the way with the engineer at his elbow to equip and control.

The properties of materials and their behaviours when lighted needed to be studied, while psychological factors and perspective geometry needed to be much more widely understood; but those things were only the tools, they were not the solutions to lighting problems.

They were not concerned only with a science, but with an art. The need at the present time was not so much to understand things as to understand people, who needed light for everything they did.

Lamp Industry Research

Survey of Technical and Manufacturing Progress

By B. P. DUDDING, M.B.E., Ph.D.

THE application of scientific knowledge has continuously guided the development of the incandescent electric lamp from its earliest form, the carbon-filament lamp of 1878, until its latest manifestation, the coiled-coil tungsten lamp, which was introduced in 1934. The progress made is represented in 60-W lamps by a five-fold increase in efficiency from 2 lumens to 11 lumens per watt.

The principle which has guided and stimulated this development is that the efficiency of light production increases as the temperature of operation rises. Appreciation of this led to the search for materials, generally metals, with higher melting points and also low rates of evaporation so as to give a practical life of about 1,000 hours. Furthermore, the material should be capable of manufacture in a filamentary form of sufficiently small diameter so that the power dissipated in a 230-V circuit should lie in the range of 10 to 100 W. In rapid succession, workers in other countries developed filaments made of tantalum, osmium, and finally tungsten by Just and Hanaman in 1904. No facilities existed for a parallel development in this country.

The development of the modern incandescent electric lamp is traced by the author who shows how scientific principles have been applied to secure increased efficiency

In its earliest form the tungsten filament was extruded through a die as a paste and enormous difficulties had to be overcome in order to produce a strong and uniform filament of the requisite diameter—0·0005 to 0·002 in. In 1909, Coolidge and his co-workers in the United States developed a method of drawing tungsten wire from metal ingots by hammering followed by drawing through diamond dies. At this stage a 230-V, 60-W lamp would yield about 9 lumens per watt for an average life of 1,000 hours.

In 1912, following research work carried out by Langmuir in America, gas-filled lamps came into being. Earlier attempts had been made to introduce gases in order to reduce the rate of evaporation of the filament, but experience had shown that when fine wires were heated in gases, so much heat was lost by transfer to the gas and subsequently to the bulb, that the lamp became less efficient rather than more, as it should have if the higher operating temperature had alone been effective. Langmuir's work led to the delightfully simple device of coiling a fine filament on another wire (afterwards dissolved away chemically) three to five times its own diameter whereby increased operating temperature could be secured without too great a loss of energy in the gas. By this means the efficiency of a 230-V, 60-W lamp was increased by 1919 to about 9·5 lumens per watt, and by 1924 to approximately 10·0 lumens per watt.

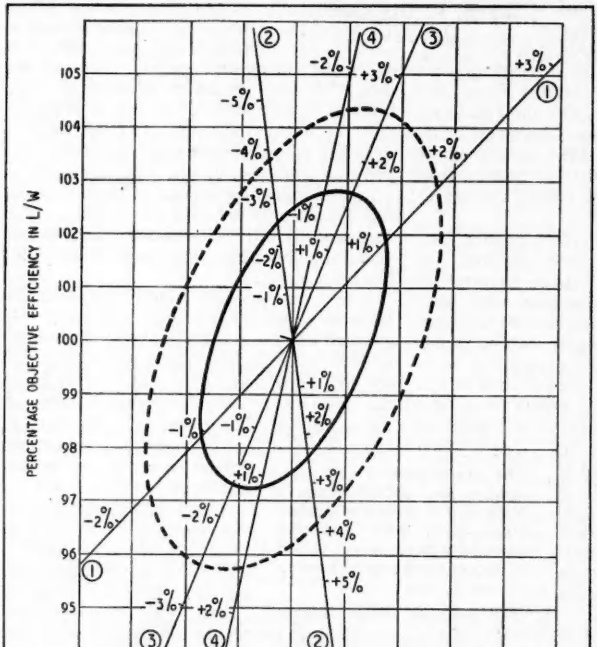
After the first world war collaboration between scientists and lamp makers in this country was provided for by the formation of industrial research laboratories, thus for the first time making possible the study of the complex problems associated with the commercial development of the small-wattage gas-filled lamp. The major problem was the production of wires less than 0·002 in. in diameter to an accuracy represented by extreme tolerances of $\pm$ 1·0 per cent and having much smaller variation in diameter along their lengths. These wires should have mechanical properties which would enable them to be coiled into spirals at high speed on other wires only about four times their own diameter and they should, in addition, have the extraordinary property of stability, even when operated for 1,000 hours, at temperatures above those at which grain growth would normally occur.

In this early collaboration a new scientific principle was introduced as an aid to the control of manufacture. It had been known for more than a century that, if in the performance of a given task, a number of relatively small disturbances operated at random, then there would be a tendency for the majority of the results to cluster about the objective and for the number of results to decrease more or less rapidly the more they deviated from the objective, the distribution of the results following a statistical law or pattern.

In its earliest forms this scientific approach to the study of results derived from the

examination of natural phenomena and man-made processes was referred to under the title " theory of probability " or sometimes " theory of errors." Mathematicians, many of them British, had also shown that when knowledge was available of how individual observations or results were distributed, then the distribution of small samples could be predicted. In the early 1920's, British workers began to use these principles to guide the control of industrial processes. A similar development was also taking place in the United States, where the term " quality control " was coined.

In England statistical principles were used as an aid to securing production efficiency (that is elimination of waste labour and material) which is interwoven with the problem of maintaining standards of quality, particularly that most desirable quality in a manufactured product—uniformity in performance. The basis of the method is to use the results of examination of samples of materials or components at various stages of manufacture so as to estimate the kind of bulk product that the processes concerned will make if they continue to operate in the designed manner. The stages of manufacture where sample inspection is introduced are ultimately determined by practical experience coupled with detailed technical knowledge based on the scientific principles underlying the process.



Influence of small changes in filament dimensions and gas composition and pressure on lamp operating characteristics

Line 1 connects changes in power consumption and luminous efficiency with small changes in filament diameter. Line 2 connects changes in power consumption and luminous efficiency with changes in pitch after coiling. Line 3 connects changes in power consumption and luminous efficiency with errors in pitch during coiling. Line 4 connects changes in power consumption and luminous efficiency with filament length

In relatively simple processes such as the mechanical manufacture of metal components, the problems are not very obscure and the introduction of statistical methods is relatively easy.* But in a complex manufacture, such as that of the electric lamp, the application of statistical methods demands much perseverance and may occupy years to become fully operative. The complexity of incandescent lamp production may be better appreciated by briefly reviewing some of its features. First, four independent industries are involved:—

(1) The manufacture, from natural ores, of metals for wires used as filaments, supporting members and vacuum-tight lead-in conductors, all of them having to satisfy stringent mechanical and physical requirements.

(2) The extraction of nitrogen and argon from the air and their preparation to a high degree of purity.

* See G.E.C. Handbook—" Quality Control Chart Technique when Manufacturing to a Specification."

(3) The manufacture of glasses in the form of cane, tubing and bulbs, to close tolerances in dimensions and physical properties.

(4) Lamp manufacturing processes involving the precision-coiling of fine wires, the maintenance of exhaust and gas-filling machines and the assembly of all the components at high speeds and, in the case of fine filaments, without deformation.

As an indication of the progress made within a few years, the number of bulbs required to place on the market 100 general lighting service lamps fell from 125 to about 105. The precision to which filaments are made is illustrated by the accompanying diagram setting out (from statistical investigations) the influence of small changes in filament dimensions and gas composition and pressure on the operating characteristics of the lamp. In a 40-W lamp, for example, with a filament diameter of about 0·001 in. and a distance between turns in the spiral of 0·00025 in., changes of 1 to 2 per cent in these dimensions are of importance.

Controlled Manufacture

As a result of ten years' continuous study and patient work, the standard of manufacture of tungsten lamps had risen in technical efficiency so that lamps produced at any time within a year were no more variable than those produced within a day. That is, the manufacture could be truly described as controlled. The British Standard Specification of 1934 bore witness to this in making provision by which random selections of lamps from the open market were required to show a variability in initial rating at marked voltage less than that represented by a coefficient of variation of 4 to 4½ per cent. By that time reputable makers could guarantee that if all lamps manufactured within a twelvemonth were tested, 95 per cent of them would fall within limits of about ± 6 per cent of their objective rating.

The advance made during this ten-year period led to another refinement, involving a small increase in cost, by which the efficiency of light production of the most commonly used small units (40- and 60-W lamps) was increased by 20 and 15 per cent respectively. This was achieved by taking advantage of the improved qualities of tungsten wire and the increased control over lamp-making processes to coil a single coiled filament on another wire, thus further reducing the loss of energy due to the gas filling of the lamp. The 230-V, 40-W lamp of this type operated at an efficiency of 10·0 lumens per watt, and the 230-V, 60-W lamp at 11·5 lumens per watt.

The desire for greater efficiency in light production has led to the association of the properties of the low-pressure discharge through mercury vapour with the properties of artificially produced luminescent materials to bring within the realms of possibility a light source of 40 W having an efficiency of 50 lumens per watt, another five-fold improvement over the coiled-coil 40-W incandescent tungsten filament lamps.

The lamp manufacturing techniques so thoroughly established between the wars had also influenced the production of electronic valves. This greatly enhanced the speed of development from the laboratory, through the manufacturing stages into full service operation, of valves, which profoundly influenced the course of the war.

Heat Pump Applications

POSSIBLE uses of the heat pump in association with air-conditioning and refrigerating installations on land and in ships are commented on in a paper prepared by Mr. F. Joder for the Institute of Marine Engineers.

The various types of heat pump are briefly described and their uses for different purposes indicated. Means of more fully utilizing existing refrigerating installations are explained; in particular, by the addition of further compression stages, they could be made simultaneously to serve as heat pumps in industrial establishments.

The air-cycle heat-pump is of particular interest in relation to ventilation and air-conditioning. The Lèbre pressure exchanger in the form of a cellular rotor of simple design may, the author thinks, in future supplant the auxiliary vapour compression machine in the air-conditioning field.

Sea water is an inexhaustible source of heat for extraction by heat pumps in passenger and cargo ships, particularly when propulsion is by diesel engines or gas turbines. Steam raising plant would then not be available, which would mean that space heating would be done by hot water or straight electrical installations.

Most large ships have refrigerating plant for air conditioning and its conversion into heat pumps could be effected at the minimum of additional capital cost. The heat exchangers would simply need to be arranged so that they could alternatively be used as condensers for heating and as evaporators when cooling.

Operating costs of various types of heat pumps are tabulated comparatively, showing that only almost continuous operation throughout most of the year with small temperature "lifts" could enable heat pumps to compete with fuel-fired plant for space heating purposes.

B.B.C. Television Masts

SUTTON COLDFIELD AND WROTHAM STRUCTURES

THE contract for the design, supply and erection of the B.B.C.'s new 750-ft television mast at Sutton Coldfield, near Birmingham, has been awarded to B.I. Callender's Cables, Ltd., as the result of competitive tenders.

The mast will be a stayed structure of an "all-up" weight of some 140 tons and the pivoted base pedestal, which is being designed to permit angular movement in any direction, will be able to withstand a maximum working thrust of 350 tons. The structure will conform with the B.B.C.'s detailed specification and be made in three sections. A triangular "support mast," 9 ft across the face and with main members of high tensile steel will extend from the base to a height of 600 ft, at which level the cross-section will change to circular and for the next 110 ft the mast will resemble a steel chimney, in the walls of which a number of rectangular holes are to be cut to form a "slot" aerial for future sound-broadcasting use. At an elevation of 710 ft the topmost stays will be attached and above these, standing as a cantilever, will be a short square tower carrying eight dipoles forming the television aerial and reaching, with its obstruction light and lightning conductor, to a height of 750 ft.

All the structural steelwork will be galvanized by the hot-dip process after fabrication. Some colour painting may be required, in addition, to the requirements of the Ministry of Civil Aviation for obstruction marking.

The mast will be supported by four sets of stays and all the ropes will be of fully locked coil construction in steel with a breaking stress of 119 tons per sq in. This type of rope consists of concentric layers of circular wires surrounded by a layer of shaped interlocking wires, minimizing inelastic stretching. All ropes will have a factor of safety of four, allowing for a coating of ice ½ in. thick throughout, simultaneously with a wind pressure approaching 60 lb per sq ft at the mast-head.

A two-man electric lift will ascend to the top of the support mast, with landings at intermediate levels. Push-button control was precluded because hanging cables had to be avoided. The car will be controlled from ground level and communication will be maintained by v.h.f. "walkie-talkie" radio sets designed by British Telecommunications Research, Ltd., one of B.I. Callender's associated companies, with the usual safety gear and mechanical overrun interlocks.

The contract is to be completed by May, 1949. It includes the provision of a second mast, 500 ft high, but otherwise similar, at Wrotham, near Maidstone, in Kent. This mast will form part of an experimental v.h.f. broadcasting station from which high power tests on different systems of modulation will be carried out.

Marconi's Wireless Telegraph Co., Ltd., is associated with B.I. Callender's for the supply and installation of the television aerial and feeders on the Sutton Coldfield mast and the feeders on the Wrotham mast.

World Power Resources

Fuel, Water Power and Electricity

A FOURTH Statistical Year Book will be published by the World Power Conference on 23rd October, covering eleven years to 1946. Data are provided on the resources, production and utilization of solid, liquid and gaseous fuels, and of water power and electricity. Figures for more than sixty countries are presented, together with such Continental and world totals as are available. Data for some mid-European countries and the U.S.S.R. could not be included.

World output of coal rose from 1933 to 1942 by annual increments of about 4 per cent. During 1943-44 total production declined and in 1945 fell to below the 1934-38 average. In the United Kingdom and in the United States coal production varied in the 1930's in sympathy with general economic conditions, but elsewhere the variations were not so marked and in Germany and Japan production advanced steadily almost into the war period.

The production of crude petroleum in the United States rose from the 1933 level by 5·4 per cent per annum up to 1945, i.e., it was nearly doubled in twelve years. Production of natural gas in the United States doubled between 1936 and 1944, while consumption increased by 71 per cent.

From 1933 to 1939 the installed capacity in electricity generating stations increased by between 13 and 20 per cent, while production increased by 58 to 78 per cent. During the war the same tendency persisted and in 1946 the capacity had risen by 40 to 47 per cent and the load by 166 per cent over the 1933 figures. The average output per unit of installed capacity in Europe rose by 90 per cent and in the United States by about 80 per cent. In North America the development of fuel-operated and water-power stations was not very different, but in Europe hydro-electric capacities increased at a greater rate.

COMMERCE and INDUSTRY

Electricity Clerks' Salary. Electrical Employment Statistics.

AN interim scheme of salaries and conditions for clerical staffs and for those engaged in legal, accounting and comparable work in the electricity supply industry was recently approved by the National Joint Council for Administrative and Clerical Grades. For general clerical workers it provides for a normal 38-hour week and a provincial salary scale rising from £135 at 16 to £385 at 32 for males and from £108 to £308 for females. Additions are to be made to these rates for employees in the Metropolitan Police Area—£10 a year from 16 to 20, £20 from 21 to 25 and £30 at 26 and over. For those engaged in legal, accounting or secretarial or other work comparable with that covered by a professional institute (but not supervisory) there are two grades :—A, £270-£450 ; and B, £450-£550. Supervisory and administrative staffs have three grades :—C, £350-450 ; D, £450-£600 ; and E, £600-£760.

British Equipment for Australia

The whole of the generating plant for the town of Mullumbimby, 560 miles by rail east of Sydney, Australia, has been supplied by the General Electric Co., Ltd., through its Australian organization, the British General Electric Co. Pty., Ltd. Further G.E.C. plant is now under construction for this undertaking.

Employment in July

We reproduce in the accompanying table figures published in the September *Ministry of Labour Gazette* which show the number of insured persons employed in electrical engineering, wiring and contracting, and the manufacture of electrical apparatus, cables, lamps, etc., at the end of July. The figures include only persons in the classes insured against unemployment before 5th July, when the new scheme came into force.

On 16th August unemployed persons in the electrical machinery section numbered 1,548 (including 425 females); in the electric wire and cable group 768 (326); in telegraph and telephone apparatus 379 (153); in radio apparatus (excluding valves) and gramophones 1,462 (703); in radio valves and electric lamps 334 (143); in batteries and accumulators 518 (310); in other electrical goods 2,278 (1,081); and in the electrical wiring and contracting industry 1,720 (57).

In another table in the *Gazette* it is shown that among other undermanned industries, 420 persons (including 47 females) were placed in the production of generating plant for electricity undertakings during the four weeks to 4th August, against 572 (74 females) in the preceding four weeks. Corresponding totals for power station construction were 306 and 480 and for Scottish hydro-electric schemes 828 and 758.

Lighting Exhibits for Science Museum

On 7th October the closing of the Darkness into Daylight Exhibition at the Science Museum, London, was marked by a short ceremony at which Mr. C. Hughes, vice-chairman of the

Mr. C. Hughes presenting a lighthouse lamp to Dr. H. Shaw to symbolize the handing over to the Science Museum of material contributed to the Darkness into Daylight Exhibition by E.L.M.A.

Electric Lamp Manufacturers' Association (in the absence through illness of the chairman, Mr. W. H. Williams) handed to Dr. H. Shaw, director of the museum, some of the exhibits which members of E.L.M.A. had contributed to the exhibition. Mr. Hughes said that the fact that the Museum had been able to arrange an exhibition devoted to the history of electric lighting and the development of the fluorescent

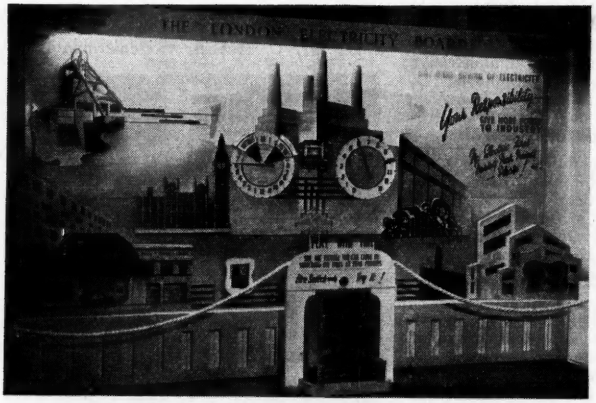
EMPLOYMENT DURING JULY (THOUSANDS)

Branch	Males (14-65)			Females (14-60)			Total		
	Mid 1939	Mid 1947	July 1948	Mid 1939	Mid 1947	July 1948	Mid 1939	Mid 1947	July 1948
Electrical engineering ..	105·9	105·3	111·8	28·0	49·0	49·5	133·9	154·3	161·3
Wiring and contracting ..	38·9	52·2	56·9	2·8	5·7	5·6	41·7	57·9	62·5
Electrical apparatus, cables, lamps, etc.	116·4	143·0	146·5	79·5	133·2	121·9	195·9	276·2	268·4

lamp had been a great source of satisfaction to the electric lamp industry. The industry had been one of the first to realize the value and importance of scientific research and it was to this policy that the nation owed the steady progress and development in electric illumination which the Museum had so graphically illustrated. During its run of just over four months the exhibition has been seen by about half a million people and now the exhibits handed to Dr. Shaw would be added to the Museum's already large collecting of lighting material for permanent exhibition.

Shoreditch Fuel Economy Exhibition

"Prepare for Winter" is the title of an exhibition staged by Shoreditch Borough Council at the Shoreditch Town Hall, to show the public how to economize in the use of fuel, light and power. The accompanying picture shows the exhibit of the London Electricity Board, entitled "Playing with Fire," which demonstrates the effects of switching on fires and luxury appliances during the peak periods.



London Electricity Board's display at Shoreditch Exhibition

Mine Mechanization in Australia

The United Kingdom Trade Commissioner at Sydney reports that the Joint Coal Board, 66, King Street, Sydney, has decided to purchase (for re-sale to mine owners) machinery to mechanize coal mines in New South Wales. The Board is to purchase the machinery overseas and, according to Press reports, expects deliveries to begin early next year. The requirements will include mobile loaders, coal-cutting machines, shuttle cars, elevating conveyors, mine locomotives and cars, belt conveyors, trailing cables, distribution cables, gate-end boxes, switchgear, electric motors and transformers. United Kingdom manufacturers in a position to supply such equipment should arrange for their Australian agents to place details of their equipment before the Joint Coal Board. The Export Promotion Department of the Board of Trade would be pleased to learn of any action taken.

Survey of Television

The British Broadcasting Corporation has issued a booklet entitled "Eye of Britain" to commemorate the part played by the B.B.C. Television Service in the XIV Olympiad. This surveys the development of the service in this country and is profusely illustrated with scenes televised inside and outside the studio. There is a special section dealing with the Olympic games, and the booklet, which is beautifully produced, is being sent to every competitor from overseas. In a postscript, Mr. Norman Collins, Controller, B.B.C. Television, refers to the 405-line British system which will remain the standard in this country for some years to come. The booklet is on sale in this country, price 2s.

Bull Motors Jubilee

This year Bull Motors (E. R. & F. Turner, Ltd.) celebrate their golden jubilee. Manufacture of these motors began in 1898 when Napier Prentice set up a factory at Stowmarket to produce quiet-running d.c. machines. Earlier he had studied under Professor Silvanus Thompson, and in 1890 had built a 20-kW generator for lighting the Paris Opera House and had exhibited a similar machine at the Edinburgh exhibition. A company was formed under the title East Anglian Engineering Co., and a factory was started to produce silent running motors and generators for country house plants.

The Bull motor became linked with E. R. & F. Turner, Ltd., in 1919 when a parent company took over control of a number of East Anglian engineering firms, and in 1924 the manufacture of the motors was moved to Ipswich. Later, in 1932, the firm became an integral part of E. R. & F. Turner, Ltd. From about 1921 onwards, the range of Bull motors was increased. Battery vehicle motors, mobile crane machines and trolley-bus motors were produced and in 1932 lift motors were introduced. The crane motors were produced in co-operation with Ransomes & Rapier, whose mobile cranes still embody Bull motors. Super-silent a.c.

motors were introduced in 1925, and fractional horse-power machines in 1935. At the same time, a standard range of a.c. industrial motors was developed.

The present works and offices at Foxhall Road were built in 1937 and the whole of the motor production was moved there in that year. The firm's contracts included predictor gear motors for anti-aircraft work, motors for radar equipment, gas filtration plants, bomber flap-operating gear, electrical transmitters, mobile A.A. guns and portable generating sets. Large quantities of motors were also supplied to munitions factories, etc.

Electricity Output

The output from solid-fuel fired generating stations in the week ended 1st October was 754·7 million kWh, as compared with 782·5 million kWh in the preceding week, and 725·1 million in the week ended 3rd October, 1947. Stocks of coal at power stations at 2nd October were 4,354,500 tons.

Jerusalem "Espionage" Trial

Following upon the dismissal of charges against Mr. W. Hawkins of the Jerusalem Electric & Public Service Corporation, reported in our last issue, the Israeli Attorney-General last week instructed the District Attorney to abandon the charge against Mr. F. W. Sylvester, another employee of the Corporation, of conspiring to blow up Ben Yehuda Street, Jerusalem in February. Later in the week the Court pronounced judgment on other charges and imposed a seven-year term of imprisonment on Mr. Sylvester for "publishing information calculated to be useful to the enemy." On charges of being in possession of and operating a radio transmitter he was sentenced to six months' imprisonment to run concurrently with the longer sentence.

The Jerusalem correspondent of *The Times* says that the only evidence produced of Mr. Sylvester's giving information was a report to the British Consulate that shells had fallen far from the power station and it was still functioning. The same correspondent also says that even the most virulently anti-British elements in Jerusalem are surprised at the verdict and the "savage" sentence imposed. An appeal has been lodged by Mr. Sylvester's counsel.

German Electrical Production

Execution of many foreign orders for electric motors, as well as the rehabilitation of German power production, is being slowed down by an increasingly acute shortage of high-quality transformer and dynamo sheets. Demand for these sheets is likely to rise to 15,000 tons for transformers and 21,000 tons for electric motors in 1949. On the other hand, the Bruckhausen works of the August-Thyssen-Hütte A.G. of Duisburg-Hamborn is now scheduled for dismantling. This plant had accounted for 35 per cent of the Western German dynamo sheet production and rolled 85 per cent of the ferro-silicon sheets required for transformers. There seems to be little chance of any other concern being able to fill the gap. The 120 electric motor producing factories in the Bizone are at present working at only about 50 per cent of capacity. In 1947, they turned out approximately 300,000 electric motors, compared with a total German production in 1938 of 2,000,000 of which about 900,000 units were produced in what are now the British and American zones.—*Reuter's Trade Services* (Frankfürt).

The Heat Pump

The Electrical Research Association tells us that it would be grateful for any information on the present use of the heat pump in this country. Details of location, plant capacity, type of drive, co-efficient of performance, source of low-grade heat, and any operating experiences, should be sent to Miss M. V. Griffith, Electrical Research Association Laboratories, 5, Wadsworth Road, Greenford, Middlesex.

Water Control Equipment for Pakistan

Ransomes & Rapier, Ltd., have received an order from the Government of Pakistan for water control gates, operating gear and other equipment for the new Barrage at Kotri on the River Indus. The order, which is valued at over £400,000, includes 31 Stoney sluice gates (60 ft span, 21 ft deep); one lock gate (60 ft span, 25 ft deep); one lock gate (50 ft span, 35 ft deep); one lift bridge (60 ft span, 30 ft wide); and 22 canal roller gates (24 ft span, 10 ft deep). The two barrage lock gates and lift bridge will be electrically operated.

Women's Engineering Society

The twenty-sixth annual conference of the Women's Engineering Society was held in Nottingham on 1st, 2nd and 3rd October. Delegates from the London, Manchester and Birmingham branches attended. The chief guests at the annual dinner on 2nd October were the Lord Mayor of Nottingham and Mrs. Florence Paton, M.P. At the annual meeting on 3rd October Mrs. F. D. Heywood, PH.D., B.SC., was elected president for 1948-49.

Iraq Import Licences

Information has been received from the Baghdad representative of the Export Promotion Department of the Board of Trade that the Iraqi Ministry of Supply has issued a notification stating that with effect from 21st September all imports into Iraq require an import licence. Goods which have already been shipped or for which firm contracts have been entered into or credits have been opened will be admitted, provided that importers apply for the necessary

licence within 30 days. Licences for goods previously subject to import licence will be considered as cancelled if they had expired before 21st September and if the importer had not entered into a firm contract or opened a credit.

Lectures on Rubber

A series of lectures will be given by the Rubber Producers' Research Association during the 1948-49 session at the Newton Heath Municipal Technical School, Manchester. They will be given on Thursdays (2.30 p.m.), from 18th November to 17th February. Particulars can be obtained from Mr. L. L. Roe, lecturer-in-charge of the Science Courses at the Technical School.

Industrial Wales

Wales is generally regarded as a coal mining, steel production and tinplate manufacturing area, but in the last ten years lighter industries have been established in many parts. The Industrial Association of Wales and Monmouthshire was formed to represent the whole industry of Wales, and it has done much to encourage the establishment of new industries and to solve the problems of the older industries. "Industrial Directory of Wales and Monmouthshire," issued by the Association, is a well-produced and illustrated book containing articles on various industries, including contributions on the South Wales Electricity Board by Mr. L. Howles and the Merseyside & North Wales Electricity Board by Mr. J. Eccles. There is an alphabetically arranged list of products and services, giving under each classification the names of firms supplying the product or service indicated, and there is also an alphabetical list of names and addresses with details of manufactures and services. The publication is obtainable from the Association at Aberdare House, Mount Stuart Square, Cardiff, price 10s. 6d.

Crane Touches Overhead Line

A lorry driver and his mate were fatally injured at Ayton, north of Berwick, on 3rd October when the jib of a crane which was being unloaded came in contact with a 33-kV overhead line.

New E.A.W. Chart

The Electrical Association for Women has added to its series of charts, which depict in coloured diagrammatic form the construction of the main domestic appliances, "The Electric Water Heater" (No. 11).

Stand-by Sets

Diesel-electric generating sets suitable for stand-by use in factories are being produced by the Electrical Engineering Construction Co., Totnes, Devon, whose export agent is F. G. Pragnell, Ltd., 21, Liverpool Street, London, E.C.2. These "Red Devon" sets, ranging from 20 to 250 kVA in capacity, are self contained and weather-protected. They may be installed in an outbuilding or shed adjacent to the main factory without necessitating the building of a special power house.

Production Efficiency

An important contribution to the current production efficiency drive, has been issued by the British Engineers' Association in the form of a monograph entitled: "Production Efficiency—the Contribution of the Engineering Industry." This work has been prepared by the Production Efficiency Committee of the Association. It reviews current thought and practice relating to production efficiency as expressed in the organizations of the leading engineering plants in this country, and thereby seeks to give guidance and stimulus to those trying to develop the undertakings in their charge on similarly progressive lines. The booklet has been issued to all members of the Association and to the eighteen trade associations affiliated to the B.E.A.

Reports on German Industry

Among the latest reports on German industrial technology made available by H.M. Stationery Office are the following:—B.I.O.S. 1771, "Fuses, Electric Protection: Fine-Sensitive and Surge-Resisting Types, below 5A, produced in Germany" (1s. 6d.); F.I.A.T. 865 (Supplement), "Six Papers on Television" (7s.); and F.I.A.T. 904, "High-Voltage Direct Current Transmission" (25s.).

Telephone Manufacture in India

The Indian telephone industry, the first national industry to be set up under the Indian Government's industrial expansion programme, will begin the assembly of automatic telephone instruments early in November. Some equipment for the first factory is expected to arrive from England this month. The plant is designed to make India self-sufficient in her requirements of automatic telephone equipment and stores. Nearly 10,000 workers will be employed when this factory goes into full production.

Mullard Sales Conference

The Sales Department of Mullard Electronic Products, Ltd., has just concluded a two-day sales conference in London attended by representatives from all parts of the country. The conference (the first since 1939) was called to give the sales staff an opportunity to make themselves familiar with future plans and policy. The chairman was Mr. L. A. Sawtell, commercial manager, Valve Division. Mr. W. Benink, manager of the Mullard Central Export Department, said that Mullard valve exports were now many times greater than in 1939, and Mr. Johns, general manager of the Valve

Division, emphasized the tremendous value of television to the radio industry and stressed the company's wide interest in electronics.

Open-Cycle Gas Turbine for Scotland

The 12,500-kW gas turbine of the open-cycle type for Dundee is now under construction, Dr. James M. M'Neill, assistant managing director of John Brown & Co., Ltd., stated in his presidential address to the Institution of Engineers and Shipbuilders in Scotland. With the increase in working temperatures, higher efficiencies and other advantages over existing practice seemed possible and he thought it safe to forecast a much wider application of this type of generator. Closer co-operation between the metallurgist and the engineer might well result in an early and new phase of development in which members of the ship-building and engineering professions would inevitably take a leading part.

Australian Electrical Trade

The Australian Bureau of Statistics has issued preliminary figures of the overseas trade of the Commonwealth for the twelve months ending June, 1948. Imports of electrical appliances and equipment were valued as follows, the comparative figures for the preceding twelve months being given also:—

Class	Year ended June 1947 £A000	1948 £A000
Batteries and accumulators ..	169	107
Cable and wire, covered	603	1,813
Dynamo-electric machines ..	1,095	2,226
Lamps, filament	196	426
Telegraph and telephone instruments, etc.	1,164	1,385
Other electrical appliances ..	2,267	4,354

Against this total import of £A10,311,000 (£A5,494,000 in 1946-47), the Commonwealth exported electrical appliances and equipment to the value of £A1,127,000 against £A3,913,000 in 1946-47.

Contract Price Adjustment Formulæ

The latest figures for use in connection with the B.E.A.M.A. contract price adjustment formulæ are as follows:—Rate of pay for adult male labour, 9th October: 115s. (unchanged). Board of Trade index figure for intermediate products, 9th October, 250·0 being the figure for September (against 249·6 for August).

Trade Announcements

The Trumeter Co., Ltd., associated with Measure-Meters Co., Ltd., has recently opened new works at Radcliffe, near Manchester. The factory is on one floor and includes die casting, hardening, spraying plant, metal finishing, machine and assembly shops. The old premises at "Sunnyside," Salford, are retained and are being used as the registered office.

Mr. A. H. Chance has joined the staff of **F. Westerman (Wholesale), Ltd.,** as outside representative for Birmingham and District. He has been engaged for the last twelve years with the Gothic Electrical Supplies.

The Hoffmann Manufacturing Co., Ltd., has opened a branch office at 18, Tempest Hey, Liverpool.

The Northern Aluminium Co., Ltd., is opening a new sales office under the management of Mr. F. Layton, 27, Park Row, Leeds, 1. The territory will include Lincolnshire, Yorkshire (with the exception of Middlesbrough), and Rutland. The company's Newcastle office is now in charge of Mr. D. M. Eadie.

The Transformer Equipment Co., St. Mark's Road, Bromley, Kent, has been established to manufacture power and audio-frequency transformers (from miniature sizes to 10 kVA), inductors and associated apparatus, to their own or customers' designs.

Bristol Repetition, Ltd., had moved to Greville Road, Bristol (telephone: Bristol 63089).

Trade Publications

Carter & Co. (Nelson), Ltd., Nelson, Lancs.—Priced catalogue of unit heaters for commercial and industrial use.

Thos. Handley & Co., Ltd., Britannia House, 74, Wellington Street, Leeds, 1.—Priced leaflet on "Ebor" candle lamps.

Universal Distributing Co., Ltd., 201-211, Bishopsgate, London, E.C.2.—Two priced leaflets on Christmas tree decoration sets, automobile bulbs, cable and miscellaneous accessories.

Falk, Stadelmann & Co., Ltd., 91, Farringdon Road, London, E.C.1.—Priced catalogue of electrical accessories, cables and flexibles, conduits, fittings and switchgear.

Talbot Tool Co., Ltd., Grip Works, Roedale Road, Brighton, Sussex.—Priced catalogue of "Grip" drill jig bushes.

Switchgear & Cowans, Ltd., Elsinore Road, Old Trafford, Manchester, 16.—Illustrated brochure (Sc. 24-23) on ring-main switchboards and non-automatic oil circuit-breakers with capacities of 75 MVA at 3·3 kV to 250 MVA at 6·6 and 11 kV.

James Sieber Equipment Co., Ltd., Africa House, Kingsway, London, W.C.2.—Leaflet illustrating "Hy-Gard-All" clothes storage hangers for cloakrooms.

Metway Electrical Industries, Ltd., King Street, Brighton, 1, Sussex.—Price list (SG.10) of immersion kettle elements and toaster.

Widnes Foundry & Engineering Co., Ltd., Widnes, Lancs.—Brochure illustrating fabricated steel vessels for the chemical, oil and allied industries.

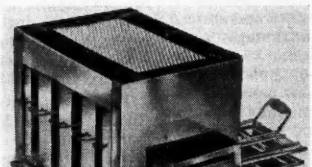
Scophony, Ltd., Wells, Somerset.—Leaflet (M/20) on miniature single-phase shaded-pole induction motors for fans.

RECENT INTRODUCTIONS

NOTES ON NEW ELECTRICAL AND ALLIED PRODUCTS

Four-Slice Toaster

IN addition to the " Raylux " domestic toaster, which is claimed to be the only model available which toasts two slices of bread simultaneously on both sides, H. A. (SALES), LTD., 66, Victoria Street, London, S.W.1, now has a commercial four-slice toaster, a special feature of which is the novel two-way loading tray which allows four slices of bread to be toasted while the remaining section of the tray can be loaded with four fresh slices. When toasted bread is pulled out, the remaining section of the loading tray automatically slides into the toasting chamber. This ensures safe, quick and handy use of the toaster, and gives maximum output. Heavy gauge brass is used for the framework and a chromium-plate finish is used throughout. The loading of the toaster is 3 kW.



" Raylux " four-slice toaster

Food Emulsifier and Mixer

A food chopper and mixer with a cake mixing attachment suitable for both commercial and domestic use is an improved version of the " Rotamix " manufactured by LEXINGTON INDUSTRIES, LTD., Hanway Works, Hanway Street, London, W.1.

The stainless steel cutters of the machine rotate at 20,000 r.p.m., producing forces within the mix sufficient to break down the toughest food fibres in a few seconds. This action makes it possible to produce a wide variety of fresh fruit and vegetable drinks and also to grind coffee and shave ice. The latest machine is of similar proportions to the original model but its external appearance has been considerably improved.

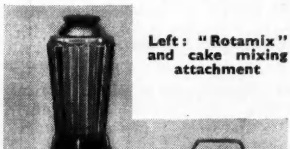
The cake attachment has a capacity of five quarts and comprises a base, incorporating a 100 to 1 reduction gearing, upon which the " Rotamix " stands to effect mechanical drive to the mixing bowl. This bowl is quickly detachable and is provided with a cake-paddle, wire whisk, epicyclic whisk and fruit reamer. The cake mixing attachment and the emulsifier are marketed as two separate units, while at a later date further accessories, using the gear box reduction drive, will become available for mincing, slicing and dicing.

Electric Massager

For invigorating the body and for treating a number of common ailments the PROVINCIAL INCANDESCENT FITTINGS CO., LTD., Pifco House, Watling St., Manchester, has brought out an electric massager. It is supplied with four different applicators for treating the face, neck, body and scalp. The comfortable white plastic pistol grip incorporates a push switch.

Drink Mixer

The " Whirl Whisk " electric drink mixer has been robustly constructed by the BRITANNIC SALES CO., 44, London Road, Kingston-on-Thames, to stand up to continuous use in



Left: " Rotamix " and cake mixing attachment

" Pifco " massager

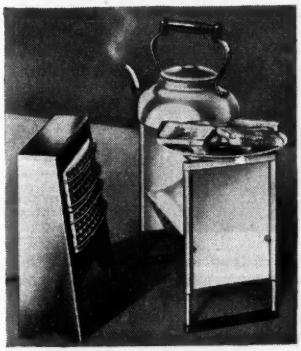
Left: " Whirl Whisk " drink mixer

a busy milk bar. Its universal motor, which can be detached in a few seconds without disturbing the wiring, has bearings which do not require attention, and a new type of automatic switch is equipped with silver sliding contacts.

An attractive all-metal construction has been adopted with a chromium-plate finish. The stainless steel spindle, which revolves at approximately 12,000 r.p.m., is offset in relation to the fluted beaker to ensure complete emulsification of liquids and to enable drinks to be mixed with extreme rapidity.

Reflector Trivet

As a contribution to economy in the use of electricity and other fuels BRITISH NATIONAL ELECTRICS, LTD., Newarthill, Motherwell, are marketing a reflector trivet which will keep food warm and a kettle on the boil by utilizing the reflected heat from an electric, gas or coal fire. It is constructed of polished aluminium and can



B.N.E. reflector trivet

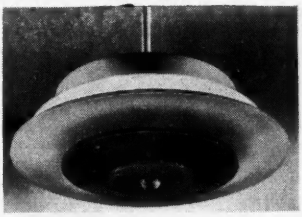
be supplied with optional flaps to give extra surface. The legs are adjustable to suit any hearth or heating element.

Cast Motor Rotors

Rotors for small squirrel cage motors are now being pressure die-cast in 99·5 per cent pure aluminium so that the bars and fan blades are integral. This method enables cooling fins to be cast on to one or both ends, so reducing unnecessary machining operations. It is less tedious, and claimed to be less expensive, than fabrication by welding or soldering copper bar connections. HIGH DUTY ALLOYS, LTD., 89, Buckingham Avenue, Slough, Bucks, can undertake the production of aluminium rotors in this way up to about 9 in. diameter by 9 in. long. Rotor and fan can be cast together, if required, and in certain cases the shaft as well can be cast as an insert. Brazing is unnecessary, so avoiding the risk of flux inclusion.

Circular Fluorescent Fitting

A 16-in. diameter 80-W circular fluorescent lamp, which operates at the same order of efficiency as the standard 5 ft tube, is incor-



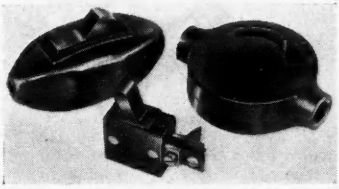
Circular "Decora" fluorescent lighting fitting

porated in a lighting fitting offered by SCEMCO, LTD., 6-7, Soho Street, London, W.1. This "Decora" fitting is of modernistic appearance, fabricated from translucent "Perspex," and is designed for flush or pendant installation, the construction permitting easy access to the control gear.

Three New Switches

ARCOLECTRIC (SWITCHES), LTD., Central Avenue, West Molesey, are introducing three new switches. The "S.700" 5-A all-insulated toggle switch, which has been specially designed for vacuum cleaners and portable tools, combines the standard roller action with wiping contacts.

For use with electric heating pads and blankets there is the "M.25" 2-A 3-heat switch with a positive action; the lettering is raised and there are moulded studs for easy manipulation in the dark. A quick make-and-break 5-A line-cord switch, the "S.800," embodies the company's patented action combining quick make and break with heavy wiping contacts.

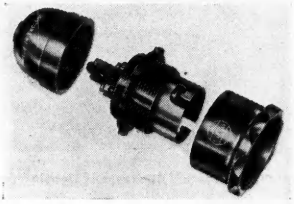


Arcolectric line-cord, toggle and blanket switches

New Types of Lampholders

Improved lampholders, including both cord grip and screwed types, have recently become available from CLANG, LTD., Crown Yard, Cricklewood, London, N.W.2. A feature of these accessories is the replacement of the more usual shade carrier ring by a robustly moulded

skirt, of equal depth to the metal bayonet holder. This provides air insulation to the lamp and gives a firm grip for fixing and unscrewing. By employing a separate plated metal holder, cracking of this section is prevented. The body of the holder is mounted in the conventional split form, but an interrupted thread avoids the difficulty of unscrewing the

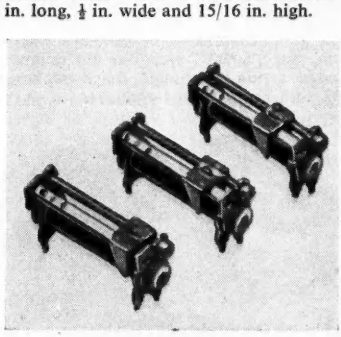


Improved "Clang" lampholder

shade carrier ring after it has been subjected to the heat of the lamp.

Pre-set Resistors

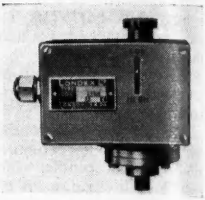
It is announced that a series of adjustable circuit-balancing or matching resistors is now being made by ELECTRO METHODS, LTD., 220, The Vale, London, N.W.11. Values of from 5 to 1,800 ohms are available, rated at approximately 3 to 4 W, which makes them suitable for many applications in electronic and industrial instrumentation circuits. They are arranged for mounting by means of a single screw through the centre of the bobbin and a screw-operated adjustment is provided for pre-setting the resistance value. The overall dimensions are $1\frac{7}{8}$ in. long, $\frac{1}{2}$ in. wide and 15/16 in. high.



Electro Methods pre-set resistors

Pressure Switch

A quick-make-and-break switch for 2-A, 230-V circuits which has been designed to operate by means of gas pressure or non-corrosive liquids is offered by LONDEX, LTD., Anerley Works, 207, Anerley Road, London, S.E.20. Switches are available to operate on pressures of from 5 to 500 lb per sq in. and each one is furnished with an adjustment of half

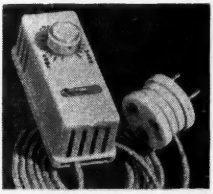


Londex pressure-operated switch

the stated pressure to full pressure. They are suitable for remote control and alarm signalling systems and are enclosed in cast aluminium casings provided with a 0·75-in. conduit entry and a pipe for 0·25 or 0·5 in. gas thread. If required, differential pressure switches can be incorporated in the same casing.

Fire Thermostat

The reintroduction of the "Teddington Adaptostat" automatic thermostat for use to control fixed or portable electric fires is announced by the BRITISH THERMOSTAT CO., LTD., Sunbury-on-Thames. The temperature range covers every domestic requirement and the instrument can be

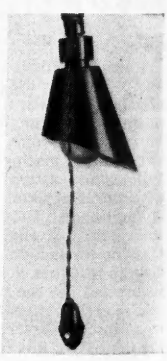


"Teddington Adaptostat"

installed without interference with the wiring in a few moments, a plug being provided to fit into the same socket as the fire. It can be carried round from room to room as required. The case is of cream bakelite.

Lamp Dimmer

A considerable saving of electricity is claimed by the use of the "Dimit" lamp adaptor made by RYNFORD INDUSTRIES, LTD., 17, Arwenack Street, Falmouth. It is especially useful for the nursery, sickroom, bedroom, staircase, hall and passage, etc., where a dim economical light



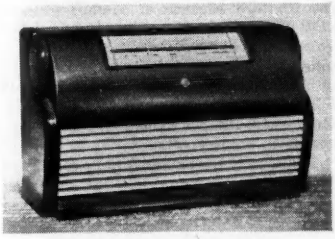
Lamp fitted with "Dimit" adaptor

is normally required but a bright light may be quickly needed in an emergency. The adaptor has another useful application in connec-

tion with television, since it gives a diffused light which enables the viewer to see clearly round the room without interfering with the clarity of the picture.

Radio Receiver

The " Ekco Consort," model " U76," transportable 5-valve, all wave, a.c./d.c. superhet radio receiver has an efficient built-in twin



" Ekco Consort " radio receiver

aerial system. Side controls preserve the attractive lines of the plastic cabinet which is available in maroon or walnut with an ivory speaker grill. The makers are E. K. COLE, LTD., Southend-on-Sea.

B.E.A. Journal

IN appearance and general make-up the first issue of the *B.E.A. Monthly Journal*, dated September, 1948, published by the British Electricity Authority, is very similar to the *I.M.E.A. Journal* which it succeeds. The purposes and aims of the *Journal* are dealt with in the first editorial note in which it is explained that the publication is not a public paper but is intended primarily for circulation amongst personnel of the Authority and will be concerned mainly with B.E.A. matters. It goes on to say:—

> " This occasion seems a fitting opportunity to acknowledge the service which the long established technical and trade electrical periodicals have given to our industry and to express the hope that they will welcome our *Journal* as complementary to their work.
>
> " It is understood to be the policy of the B.E.A. to keep the technical and trade press informed on all their activities which affect the industry in general, and for B.E.A. engineers and officers to continue to regard the technical and trade press as the appropriate channels for publication of articles and general contributions of concern to the electrical industry at large."

The contents include a message from Lord Citrine (chairman of the B.E.A.) and notes and articles on a number of matters which are relevant to the Authority's work and of interest to its people.

Engineers and Social Progress

SOME of the many ways in which the engineer has contributed and still is contributing to social progress were indicated by Mr. S. R. Mellonie (engineer, No. 1 sub-area (Manchester) of the North Western Board, formerly with Salford Corporation) in his address as chairman of the I.E.E. North-Western Centre.

A number of examples were quoted to illustrate how increasing output per man-hour depended upon the use of mechanical power, while it was technical improvement brought about by engineers that had enabled working hours to be shortened.

The growth of electrical methods in applied science was well illustrated by the electrical diagram, which was now used as a tool for many purposes widely different from the original purpose. The earliest diagrams, consisting of symbols connected by lines, were intended merely to indicate the connections between machines and apparatus. The next stage utilized such diagrams to indicate a function or property of the combination of symbols. A considerable step forward was made when the equivalent diagram of a machine was drawn to form the basis of a mathematical investigation of the performance of the machine represented. Still more recently diagrams had been drawn in both two and three dimensions to facilitate the solution of partial differential equations. When those models were set up on an analyser, numerical solutions of practical equations could be obtained. Hence it appeared that to some extent the electrical diagram represented an alternative method of writing a mathematical expression and might ultimately form the basis of an international science language free from ambiguity.

Real Wealth

Turning to economic factors, it was argued that a financial surplus was not an index of an organization's service to the community; neither was a loss any criterion of uselessness and, further, an engineer was forced to the conclusion that a national unit was not necessarily an economic unit. Wide adjustments might be necessary in future if economic soundness was to be regarded as essential to survival. Real wealth could only be created by work of some kind.

The form of society was not beyond the control of the people forming that society. The test of the structure was the facilities it provided for absorbing the ideas and utilizing the efforts of its members. An acceptable yardstick with which to measure efficiency was an urgent necessity for nationalized industries. The old device of comparing similar undertakings was no longer applicable. Statistics might be the index, if interpreted independently against a background of social responsibility and public enterprise.

FINANCIAL SECTION

Company News
Stock Exchange Activities

Reports and Dividends

Hoover, Ltd.—At an extraordinary meeting held on 5th October Mr. C. B. Colston (chairman and managing director) said that the sellers' market was coming to an end. Despite difficulties, their turnover in respect of electrical cleaners for the current year to the end of September had shown a substantial increase over the same period for 1947. Their turnover on fractional horse-power motors had been more than double and a much higher proportion had gone for export this year. Their subsidiary Hoover (Washing Machines), Ltd., had started production in February last at Merthyr Tydfil and had shown a rapid rate of increase. So far 94 per cent of their output of electric washing machines had been sold for export.

Resolutions were carried sub-dividing the unissued 5½ per cent £1 cumulative preference shares so that each becomes four shares of 5s. each to be converted into ordinary shares.

Underwriting has been arranged for the issue of ordinary shares. Ordinary stockholders are to be offered 540,000 5s. ordinary shares at 34s. 6d. each. Any shares not taken up by ordinary stockholders will be available to preference stockholders and to " A " ordinary shareholders. The net proceeds of the issue will be used to repay bank loans and to finance recent extensions of the business to the manufacture of fractional horse-power motors and washing machines.

Holophane, Ltd., reports a net profit for the year ended 30th June last of £43,264, as compared with £34,003 for the preceding year. After providing £20,000 for tax and writing off £913 from goodwill and patents, there is a balance of £22,351 (against £11,326). The final dividend is 7½ per cent, again making 15 per cent for the year and £37,598 is carried forward (against £23,498 brought in).

Lightalloys, Ltd., proposes to pay a final dividend of 10 per cent, making 15 per cent for the year (same). The profit for the year amounted to £21,223 (excess profits tax recovery nil), against £16,195 (which included £15,000 E.P.T. recovery). The provision for taxation is £13,750, leaving a net profit of £7,473 (£8,695). In addition a further £5,272 E.P.T. is recoverable in respect of the previous period.

Telephone Properties, Ltd., reports a net profit of £14,186 for 1947, as compared with £34,320 for the preceding year. The ordinary dividend for the year is maintained at 6 per cent, less tax. The directors state that owing to a change in accounting procedure in the method of dealing with dividends from an associated company, the profits for 1946 and 1947 are not comparable.

The Ever Ready Trust Co., Ltd., is paying an unchanged interim dividend of 3 per cent on the ordinary stock and deferred shares.

The Marconi International Marine Communications Co., Ltd., is paying an interim dividend of 2½ per cent (same).

The Watford Electric & Manufacturing Co., Ltd., has announced an interim dividend of 5 per cent (unchanged).

Solus Teoranta (electric lamp manufacturers, Eire) have declared a final dividend on the " A " and " B " shares of 5 per cent (against 2½ per cent), making 10 per cent for the year (against 7½ per cent).

Chadburns (Liverpool), Ltd., is paying a dividend of 3 per cent, less tax (against nil) for the year ended 31st March last. The profit for the year is £3,551 (against a loss of £4,481).

New Companies

Allen & Pope, Ltd.—Registered 30th September. Capital, £500. Manufacturers of electric light fittings, general and electrical engineers, etc. Directors: H. Stein, B. J. P. Allen and A. E. Bodley. Regd. office: Finsbury House, Blomfield Street, E.C.2.

Malcolm E. Rowe, Ltd.—Registered 30th September. Capital, £1,000. To acquire the business of an electrical contractor and dealer in radio and electrical goods carried on by M. E. Rowe as M.E.R. Services at 166, Ashley Road, Hale, Altrincham, Ches. Directors: M. E. Rowe, M. Rowe, Mrs. E. Rowe and Mrs. J. I. Rowe. Regd. office: 166, Ashley Road, Hale, Altrincham, Ches.

A. R. Burns & Son, Ltd.—Registered 28th September. Capital, £1,000. To acquire the business of radio and electrical engineers carried on by A. R. Burns and E. Ironside as A. R. Burns & Son at 8, Western Road, Shoreham-by-Sea, Sussex. Directors: C. Lewery, T. Morris and A. R. Burns. Regd. office: 8, Western Road, Shoreham-by-Sea.

H. & G. Electric (Feltham), Ltd.—Registered 28th September. Capital, £1,000. Electrical engineers and contractors, radio engineers, etc. Directors: A. W. Hughes and F. Naylor. Regd. office: 3, Spring Corner, High Street, Feltham, Middlesex.

Electric Test Co. (Etco), Ltd.—Registered in Dublin 20th September. Capital, £100. To buy, sell, manufacture and repair instruments of all kinds, including surgical, drawing, surveying, optical and laboratory apparatus and fittings, etc. Subscribers: Margaret H. Walsh and A. Dudley, 16, Molesworth Street, Dublin.

Morris & Curnow, Ltd.—Registered 23rd September. Capital, £2,000. Manufacturers of, and dealers in, electrical appliances and apparatus, etc. Directors: A. J. Curnow,

F. D. Curnow, A. D. Curnow and M. A. Curnow. Regd. office: 3, Cambridge Road, King's Heath, Birmingham.

Seymour Street Battery Service Co., Ltd.—Registered 23rd September. Capital, £1,000. Directors: G. Mari and M. Schiavetta. Regd. office: 4, Harcourt Street, Marylebone, W.1.

Singleton, Nelson & Co., Ltd.—Registered 27th September. Capital, £1,000. Manufacturers and repairers of, and dealers in, electrical and mechanical apparatus and accessories, radio and television sets, etc. Directors: B. Singleton and J. Nelson. Regd. office: The Brickyard, Edwalton Hill, West Bridgford, Notts.

Ernest B. Davis, Ltd.—Registered 24th September. Capital, £3,000. Electricians, electrical contractors, electrical, mechanical and radio engineers, etc. E. B. Davis signs as director. Regd. office: 44, Gerard Street, Ashton-in-Makerfield.

Lamont Bros. (Ventilations), Ltd.—Registered 24th September. Capital, £3,000. Ventilating, heating, lighting, hydraulic, electrical, radio, motor and general engineers, etc. Directors: J. E. Lamont and F. J. Lamont. Regd. office: Bristol House, 19-20, Holborn Viaduct, E.C.1.

Auto Electric Services (Scunthorpe), Ltd.—Registered 28th September. Capital, £6,000. To acquire the business of an automobile electrical engineer and electrical armature winder carried on by E. Rounce at 24, Normanby Road, Scunthorpe, as Auto Electric Services. Directors: E. Rounce and five others. Regd. office: 24, Normanby Road, Scunthorpe, Lincs.

Hughes & Southam, Ltd.—Registered 1st October. Capital, £1,000. Electrical engineers, general electrical installation contractors, etc. Directors: W. Hughes and G. Southam. Regd. office: Fountain House, 81-3, Fountain Street, Manchester, 2.

Runbaken Electrical Products Distributors (Ireland), Ltd.—Registered in Dublin 29th September. Capital, £1,000. Distributors and manufacturers of, and dealers in, electrical and other goods, accessories for cinema, theatre, household and commercial use and for radio and television, etc. Directors: J. H. Runbaken, Miss N. Hogg, M. Baum, and F. Hyman.

Increases of Capital

Duralite, Ltd.—Increased by £10,000, in £1 ordinary shares, beyond the registered capital of £120,000. The new shares are designated "I C F C" shares. The capital is now divided into 130,000 ordinary shares, those numbered 67,001 to 100,000 are called "Duro Test Shares," 47,001 to 67,000 "Acons English Shares," share numbered 1 and shares numbered 18,503 to 36,001 are called "Edron Shares," shares numbered 3 to 18,502 "Endolithic Shares," shares numbered 2 and shares 36,002 to 47,000 "Wyborn Shares," 100,001 to 120,000 "Acons Scottish Shares," and 120,001 to 130,000 "I C F C Shares."

Newton Victor, Ltd. (formerly Victor X-Ray Corporation, Ltd.).—Increased by £52,000, in £1 ordinary shares, beyond the registered capital of £200,000. On 18th May the General Electric X-Ray Corporation of Chicago, U.S.A., held 39,998 shares, and Associated Electrical Industries, Ltd., 159,991 shares.

Companies to be Struck Off Register

Unless cause is shown to the contrary the following companies will be struck off the register at the expiration of three months from 8th October:—Cabôt Radio Mfg. Co., Ltd.; Discharge Lamps, Ltd.; Electrical Equipments (Northern), Ltd.; Lawes Radio & Electrical Co., Ltd.; North West Electrical Co., Ltd.; Reliable Radio, Ltd.; and Sound Amplifiers, Ltd.

Winding-up Petition

British Electronic Appliances, Ltd.—A petition for the winding-up of this company has been presented to the High Court by E.M.I. Sales & Service, Ltd., and will be heard in London on 18th October.

Liquidations

C. & D. Electric (Appliances), Ltd.—In voluntary liquidation. Particulars of claims by 15th November to Wilkinson, Lawson & Co., 24, Acresfield, Bolton, solicitors to the liquidator, Mr. A. T. Eaves.

Crittall Kitchen Equipment Co., Ltd.—Winding up voluntarily. Liquidator, Mr. D. Morgan, 19, St. Martin's Street, Leicester Square, London, W.C.2.

Channel Conduits, Ltd.—Winding up voluntarily. Liquidator, Mr. R. W. West, of West, Wake, Price & Co., 6, Broad Street Place. London, E.C.2.

Bankruptcies

Barnett Supplies Co., radio and television dealers, 102, Cranbrook Road, Ilford.—Receiving order made 1st October on a creditor's petition. First meeting 18th October at 20, Eaton Place, London, S.W.1. Public examination 26th November at the Shire Hall, Chelmsford.

F. J. Jervis, radio engineer, 29, 29A and 29B, Guildford Road, Woking, and 55, Florian Avenue, Carshalton, trading as "Surrey Radio & Electric Services."—Trustee, Mr. A. E. Attwood, 90, Queen Street, Cheapside, London, E.C.4, released 14th September, 1948.

C. A. Jay, electronic instrument maker, trading as "A. G. Jay & Co.," 32, Clayton Street West, Newcastle-on-Tyne.—Proofs for dividends by 23rd October to the trustee, Mr. A. K. Ferguson, Official Receiver, Gibb Chambers, Westgate Road, Newcastle-on-Tyne.

STOCKS and SHARES

THE strength of the market in gilt-edged securities remains the outstanding feature in the Stock Exchange. As noted on previous occasions, the more conflicting that developments in politics, international and domestic, become, so much more persistently does money seek the security of "safety first" stocks. British Transport 3 per cents for the first time have reached 100 bid, and Electricity 3 per cents again advanced, this time to 101¾. Holders of the stocks and shares who were given, and have retained, these two issues in exchange for their previous interests, are probably as surprised as pleased to see the popularity which the stocks have achieved, the rises being due, of course, to sympathy with other British Government securities.

Highlights

British Transport 3 per cents century made a double event, on the same day of last week, with a first recorded bargain in British Electric Traction deferred at 2,000. Transport "threes" include a few weeks' interest in the price. This just denies the claim that former railway stockholders will get, at 100, full value for their compensation stock. Nevertheless, a six points recovery in as many months does much to mend the damage caused to both capital and common justice by the initial discount on the stock. The price was 1625 on the day before publication of Thomas Tillings' deal with the Transport Commissioners. This week's rise has lifted it to 2,045. Tillings are now all but £6.

Changes on the Week

Apart from the movements in British Electric Traction deferred stock and Thomas Tilling shares, the alterations in prices on the week are mostly modest. Gains of 2s. 6d. are shown by Tube Investments at 6¼ and Chloride Electrical at £5, Electrical Components at 12s. 6d. are 1s. 3d. up. A similar advance has been secured by Vactric, 9s. 6d. English Electric 47s. 6d., and East African Power 46s. General Electrics strengthened to 86s. 3d. Cable & Wireless at 205 is a point higher. Cossor, 10s. 6d., and E.M.I., 18s. 9d., are a firmer market. Babcock & Wilcox at 71s. 9d. are better, in company with shares in most of the other "heavy" industry companies. Aberdare Cables, 61s., are harder, and so are De la Rue, 39s. 6d., Cromptons, 27s., Laurence Scott, 14s., and Hoover, 37s. 6d. On the other hand, Henleys lost a few pence at 24s. 6d., and Cape Electric Trams at 31s. 3d. are $\frac{1}{16}$ down.

Anglo-American Telegraph

Anglo-American Telegraph preferred stock has received a dividend of £5 8s. in respect of the past year, against the 6 per cent to which it is properly entitled. Until the preferred stock receives its full 6 per cent the deferred can, of course, obtain nothing, and pending the result of the Western Union appeal, it is impossible to assess the value of the junior issue. If the decision should go against the Anglo-American Telegraph, the company could probably maintain a £5 8s. per cent dividend on the preferred, which, accordingly, appears to be priced at approximately the proper level. If the company won, however, the price would certainly go better, taking with it the deferred in its train.

Victoria Falls & Power

Not until the end of the year will the holders of ordinary shares in the Victoria Falls & Power Company learn how much they are likely to be given in payment for their shares. At the meeting last month the chairman dealt, amongst other things, with the position of the preference shareholders, to whom he held out little hope that they will receive more than their pound of flesh; that is, 20s. per £1 share, for their interests when these are taken over. In the Stock Exchange market, it is thought that the ordinary shares will get something between the present price of 7⅜ and £8, when the final distribution comes to be made.

The Preference Shares

Some little sympathy is expressed with the Victoria Falls & Power preference proprietors who bought their shares, in many cases, with the intention of holding them until expropriation two years hence, and who are now to receive only the par value, without any compensation. It is contended that another 1s. or 2s. per share would at any rate help to mollify the feelings of the preference holders, and at very little cost to the ordinary shares. However, according to present arrangements, the preference shareholders are to be paid the amount to which they are lawfully entitled. Whatever else comes to them, can only be as a matter of grace from the holders of the ordinary capital.

Five Per Cent Upwards

An interesting selection can be made from the higher yielding issues on offer in the electrical equipment market. Returns of 5 to 5½ per cent are shown by a well-assorted group including Brush 5½ per cent preference at 21s., Electric Constructions at 48s. 3d., Ever Ready at 36s., Hoovers at 38s. 9d., Scottish Cables at 23s., Hackbridge & Hewittic at 11s., Anglo Portuguese Telephone at 30s. 6d., and Pye deferred at 25s. Between 6 and 6½ per cent is the current yield on Switchgear & Cowan, 16s. 6d., Aron Meters, 50s., General Cables, 15s. 9d., Hackbridge Cables, 15s. 9d., and Telephone Properties at 19s. In the higher ranges are E. K. Cole ordinary at 15s. 6d., yielding 7¼ per cent and the preferred at 24s., giving over 8 per cent; Hall Telephone at 13s. 9d. pay 7½ per cent, Aerialite at 15s. 6d. over 9½ per cent, and Morphy Richards—on which the dividend has lately been maintained at 160 per cent—give a double-figure return at 16s.

Next Week's Events

Monday, 18th October

BIRMINGHAM.—Grand Hotel, 6.15 p.m. Birmingham Electric Club. Film entitled "Sheet Metal Manufacture at the Works of J. Summer & Sons, Ltd." Commentary by S. A. Lewitt.

LIVERPOOL.—Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey and North Wales Centre. "Load Dispatching and the Reasons for it, with special reference to the British Grid System," by A. R. Cooper.

LONDON.—St. Ermins Hotel, S.W.1, 6.40 p.m. A.S.E.E. Central London Branch. "Electric Water Heating," by P. Honey.

At the Geological Society, Burlington House, Piccadilly, W.1, 5.30 p.m. Society of Chemical Industry (Chemical Engineering Group). "Recent Developments in High Vacuum Technology," by R. S. Morse.

NEWCASTLE-ON-TYNE.—King's College, 6.15 p.m. I.E.E. North-Eastern Radio and Measurements Group. Addresses by F. Smith and Dr. S. Whitehead, chairmen of the Radio and Measurements Sections.

SHEFFIELD.—At the Sheffield Metallurgical Club, West Street, 7.30 p.m. Junior Institution of Engineers (Sheffield and District Section). Annual general meeting and chairman's address.

Tuesday, 19th October

LEEDS.—Yorkshire Electricity Board Offices, 1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilization Group. "Factors Governing Specifications for Flexible Electric Cables," by W. Bowen.

LONDON.—Lighting Service Bureau, 2, Savoy Hill, W.C.2, 6.15 p.m. Association of Supervising Electrical Engineers. Presidential address by A. G. Ramsey.

Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio Section. Discussion on "What should be the Design Considerations of Services' Radio Equipment?", opened by S. J. Moss and G. C. F. Whittaker.

NOTTINGHAM.—Y.W.C.A., 6.30 p.m. I.E.E. East Midland Centre. "The Application of Electricity to Horticulture," by C. A. Cameron Brown and E. W. Golding.

Wednesday, 20th October

BRIGHTON.—Technical College, 6.30 p.m. I.E.E. Southern Centre. "Standardization of Switchgear," by D. E. Lambert and J. Christie.

LANCASTER.—Storey Institute Technical College, 6.45 p.m. I.E.E. North-Western Centre. "The Application of Electricity to Horticulture," by C. A. Cameron Brown and E. W. Golding.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. Chairman's address by C. O. Boyse.

I.E.E. London Students' Section, 2.15 p.m. Visit to Evershed & Vignoles, Ltd., Chiswick.

MAIDSTONE.—Royal Star Hotel, 7.30 p.m. A.S.E.E. Kent Branch. "Earthing and Testing," by H. Coulls.

MANCHESTER.—Engineers' Club, Albert Square, 6.30 p.m. I.E.E. North-Western Radio Group. "The Velodyne," by Prof. F. C. Williams and Dr. A. M. Uttley.

Thursday, 21st October

DUBLIN.—Trinity College, 6 p.m. I.E.E. Irish Branch. Chairman's address by H. J. Guthrie.

LONDON.—Dorchester Hotel, Park Lane, W.1, 7 for 7.30 p.m. Institution of Mechanical Engineers. Annual dinner.

Caxton Hall, Westminster, S.W.1, 2.30 p.m. Diesel Engine Users' Association. "Diesel Fuel Research at Thornton Research Centre," by C. G. Williams.

RUGBY.—Electricity Showrooms, 6.30 p.m. I.E.E. Rugby Sub-Centre. Chairman's address by R. G. A. Dimmick.

Friday, 22nd October

BIRMINGHAM.—Grand Hotel, 7 for 7.30 p.m. Birmingham Electric Club. Dance.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 7 p.m. Joint meeting of the Cardiff Branch of the E.A.W. and the Illuminating Engineering Society (Cardiff Centre). "The Educational Work of the E.A.W.", by Miss Vera Norvick.

LONDON.—Caxton Hall, S.W.1, 6.30 p.m. E.P.E.A. (Southern Meter Engineers' Group). "The Growth of Accuracy of Measurement from 7000 B.C. to Modern Times," by W. T. O'Dea.

Storey's Gate, S.W.1, 6 p.m. Institution of Mechanical Engineers. Presidential address by Capt. W. Gregson.

39, Victoria Street, S.W.1, 6.30 p.m. Junior Institution of Engineers. "The Influence of Lighting on Industrial and Domestic Accidents," by S. L. Lyons.

NEWCASTLE-ON-TYNE.—King's College, 7 p.m. I.E.E. North-Eastern Students' Section. "The Cartridge Fuse. Its Use and Performance in A.C. Circuits," by R. W. Shield.

Information Department

THE extensive records of our Information Department enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the makers of the following:—

"Colombo" electric toasters.

"Maglow" electric fires.

General inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by the Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Electricity Supply

Dunston "B" Breakdown. I.O.M. Water Power.

Birkenhead. — STREET LIGHTING. — The Minister of Health has now approved the Corporation's scheme for street lighting on the Windermere estate, Upton, and subject to the approval of the Finance Committee it is proposed to accept the Merseyside and North Wales Electricity Board's estimate of £1,306 for carrying out the installation.

Doncaster. — PROTEST AGAINST POWER STATION.—Doncaster Civic Trust is to hold a meeting on 26th October to protest against the decision of the British Electricity Authority to build a new power station half a mile from the town centre, at Crimpsall Ings. The chairman of the executive committee of the Trust says the scheme is "a disgraceful example of bad planning," and will result in offensive fumes polluting the air of Doncaster.

Dunston-on-Tyne. — ALTERNATOR BREAKDOWN.—Press reports have appeared of an explosion and fire at Dunston "B" power station on the afternoon of 5th October which damaged a 48,000-kW alternator. As a result, it was stated, load shedding had already taken place in the area and would be heavier next winter than had been expected. The British Electricity Authority states that the supply to consumers was not affected at the time of the breakdown, though some load was shed on the following day. A set of similar capacity now under maintenance will be put into commission within the next few days, and the repairs to the damaged machine will take only a few weeks to carry out, so the position is much better than earlier reports seemed to indicate.

Isle of Man.—REPORT ON HYDRO-ELECTRIC DEVELOPMENT.—The Commission appointed to consider the possibility of hydro-electric development in the island has reported in favour of a scheme estimated to cost some £800,000 which would result in 7,500 tons of coal a year being saved.

London.—NORTHERN OUTFALL WORKS.—The Housing Committee of the L.C.C. reports that the electricity supply at the northern outfall works is d.c. generated in the works with a capacity of 400 kW. The present programme of improvements at the outfall works requires a guaranteed supply of electricity with a capacity of 1,000 kW by 1952 rising to over 1,500 kW by 1957. To meet these requirements it is proposed that a.c. shall be used for power supply in future, obtained for a time from the British Electricity Authority. The Gas Light & Coke Co. is negotiating with the British Electricity Authority for a supply of electricity to its adjoining Beckton works, and the cost of the new cables and switching station required would be borne jointly by the Gas Co. and the Council. The scheme would provide a capacity of 2,000 kW for the Council's requirements at an estimated cost of £35,000. Cables and plant, estimated to cost £19,000 of this amount, would be required if it was decided to utilize sludge gas to generate electricity on completion of the major sludge digestion plant, and cables and the switching station accounting for the balance, £16,000, would still be of service as an alternative source of power for emergency use. It is not expected that any expenditure will be incurred during the current financial year.

Nottingham.—NORTH WILFORD OUTPUT.—A report recently presented to the City Council states that the output from the North Wilford generating station for the year ended 31st March last was 547·5 million kWh, an increase of 43 per cent as compared with the previous year. Of this, the undertaking sold 261 million kWh and exported 213·5 million kWh to the Central Electricity Board. Largest consumers in the undertaking's area were: domestic premises 126 million kWh, factories and industrial premises 91 million kWh, shops, commercial premises, public buildings, etc. 27 million kWh, trolley-buses 13 million kWh. In presenting the report Councillor G. H. Wigman said that in spite of increased costs the undertaking still made a profit, and this, together with the balance brought forward from the previous year, enabled it to contribute £61,500 to the rates.

Overseas

France.—POWER PROGRAMME INSUFFICIENT.—In the opinion of M. Albert Caquot, speaking at a meeting of the French Power Equipment Committee, the Monnet Plan for electrical equipment should be doubled. On the basis that consumption doubles every ten years, he said that at the present rate of construction France would only increase her power deficit.

TRANSPORT

Sunderland.—LOSS ON TRAMWAYS.—The annual report of the Corporation transport manager (Mr. C. A. Hopkins) states that during the year ended March last, the trams made a loss of £17,134, the first deficit since the undertaking began in 1901. There was a profit of over £16,000 on the buses, but after paying income tax and interest on capital, there was an overall deficit on the transport system of £4,888. Operating costs for the trams were 22·706d. per mile or about 2d. a mile more than receipts. The trams carried 54·3 million passengers, a considerable increase on the previous year. Following approval from the Ministry of Transport, higher tram and bus fares have been introduced by the Town Council.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1944

CARDOX (Great Britain), Ltd., E. A. Loring and A. Ignatieff.—" Electrical connectors for blasting cartridges." 2634. 12th February, 1944. (608757.)

British Thomson-Houston Co., Ltd.—" Electrode holders." 7036. 17th April, 1943. (608847.)

Autophon Akt.-Ges.—" Loud-speaking telephone systems." 18710. 15th January, 1944. (608850.)

General Electric Co., Ltd., and L. C. Jesty.—" Transmitting apparatus for the television of motion-picture film." 20490. 23rd October, 1944. (608939.)

1945

General Electric Co., Ltd., and M. Wadely.—" Mixer circuits, for example for superheterodyne receivers." 4651. 23rd February, 1945. (608855.)

Autophon Akt.-Ges.—" Rectifier arrangement." 5805. 4th December, 1942. (608856.) " Device for switching-in and disconnecting signal apparatus." 5806. 4th December, 1942. (608857.)

Marconi's Wireless Telegraph Co., Ltd.—" Lens for ultra-high-frequency electric waves." 10213. 22nd April, 1944. (608949.)

Marconi's Wireless Telegraph Co., Ltd.—" Electron discharge device and radiator." 17107. 1st January, 1944. (608952.)

Faximile, Inc.—" Electrolytic recording electrode." 17295. 11th September, 1941. (608953.)

Soc. d'Electro-Chimie, d'Electro-Metallurgie et des Acieries Electriques d'Ugine.—" Weld rods for depositing hard metallic layers on the surface of metallic pieces." 18450. 8th October, 1943. (608957.)

Telefonaktiebolaget L. M. Ericsson.—" Contact spring sets for relays and similar switching apparatus." 21059. 18th August, 1944. (608960.)

B. M. Hadfield.—" Electronic pulse counting arrangements." 22821. 5th September, 1945. (608763.)

British Thomson-Houston Co., Ltd., and H. S. Holbrook.—" Protection of electrical apparatus against transient over-voltage." 23753. 14th September, 1945. (608962.)

G. Roth.—" Apparatus for projecting thermal or visible or ultra-violet radiation." 24569. 21st September, 1945. (608864.)

G. Longo.—" Short-wave antenna." 25138. 8th May, 1945. (609032.)

Plessey Co., Ltd.—" Vibrator test circuit." 29778. 21st November, 1944. (608869.)

Compagnie Generale d'Electricité.—" Manufacture of coaxial cables with insulating wedges." 31677. 24th January, 1945. (608875.)

Naamlooze Vennootschap Philips' Gloeilampenfabrieken.—" Devices for the stereophonic transmission of sound." 32152. 22nd August, 1940. (609037.)

Farnsworth Television & Radio Corporation.—" Apparatus for reproducing an image of an object." 33027. 11th May, 1945. (608769.)

British Thomson-Houston Co., Ltd.—" High-frequency generators." 33033. 9th December, 1944. (609038.)

1946

Philco Products, Inc.—" Electrical vacuum tube amplifying systems." 649. 8th January, 1945. (609041.)

Allmanna Svenska Elektriska Aktiebolaget.—" Compressed air valves for electric circuit-breakers." 900. 12th January, 1945. (609042.)

Marconi's Wireless Telegraph Co., Ltd.—" Pulse communication repeater system." 958. 7th April, 1944. (608778.)

Wilcolator Co.—" Thermostatic electric control devices." 1666. 15th March, 1944. (608879.)

R. Reddin.—" Electric water heaters." 1691. 17th January, 1946. (608880.)

Compagnie Generale d'Electricité.—" Electric cables." 2421. 1st June, 1944. (608784.)

British Thomson-Houston Co., Ltd.—" Frequency dividers." 2879. 9th October, 1942. (608882.)

W. F. F. McMillan.—" Electro-magnetically operated switches." 3543. 27th February, 1947. (609116.)

Westland Aircraft, Ltd., and P. J. Swaffield.—" Thermal delay action electric switches." 4214. 11th February, 1946. (608786.)

Marconi's Wireless Telegraph Co., Ltd.—" Multiplex communication system." 4571. 29th November, 1943. (608887.)

E. G. L. Roberts.—" Manufacture of electric wires and cables." 4673. 14th February, 1946. (608889.)

Marconi's Wireless Telegraph Co., Ltd.—" Radio systems, suitable for lifeboat service." 5347. 8th January, 1945. (608891.)

British Thomson-Houston Co., Ltd.—" Filament joints for electric lamps or similar devices." 5819 1st March, 1945. (608894.)

Soc. des Accumulateurs Fixes et de Traction.—" Electric storage batteries and accumulators." 5948. 19th January, 1946. (608896.)

British Thomson-Houston Co., Ltd. (General Electric Co.).—" Cathode-ray screens." 6286. 28th February, 1946. (608789.)

J. L. Taylor and A. E. Taylor.—" Fluid-pressure-actuated electric switches." 6341. 1st March, 1946. (608797.)

General Electric Co., Ltd., and W. G. Thompson.—" Electric current measuring arrangements." 6404. 1st March, 1946. (608804.)

E. I. Du Pont de Nemours & Co.—" Electrolytic production of light metals." 6411. 1st March, 1945. (608805.)

Teddington Controls, Ltd., and E. J. Bush.—" Thermostatic control devices." 6428. 1st March, 1946. (608811.)

Hazeltine Corporation.—" Electric pulse generating circuit." 6460. 14th March, 1945. (608817.)

New Day Electrical Accessories, Ltd., and L. E. W. C. N. Davey.—" Electric switches particularly tumbler switches." 6463. 1st March, 1946. (608820.)

M. Widakowich.—" Electric current converters." 6502. 1st March, 1946. (608901.)

Concordia Electric Safety Lamp Co., Ltd., and C. H. Steadman.—" Electric circuits applicable to fluorescent tubes." 6507. 1st March, 1946. (608903.)

J. M. M. Pinkerton, E. K. Williams and D. W. Pugh.—" Electric switch devices." 6517. 1st March, 1946. (608906.)

General Electric Co., Ltd., N. R. Bligh and A. Bloch.—" Radio-communication systems." 6541. 2nd March, 1946. (608909.)

Walsall Conduits, Ltd., and E. Gough.—" Plug-and-socket connectors for electric circuits." 6597. 4th March, 1946. (608976.)

F. W. G. Greener.—" Electric domestic heating devices." 6611. 4th March, 1946. (608979.)

E. St. J. Chesney.—" Vibrators for changing the voltage and/or frequency of electric current." 66134. 4th March, 1946. (6089801.)

General Electric Co., Ltd., G. M. Wells and J. M. Sutton.—" Mounting of piezo-electric quartz crystal elements." 6634. 4th March, 1946. (608986.)

Aktiebolaget Separator and H. W. Thylefors.—" Lining-up arrangement for electric motors." 6650. 4th March, 1946. (608990.)

British Thomson-Houston Co., Ltd., and J. Moir.—" Wired radio signalling systems." 6654. 4th March, 1946. (608991.)

Compagnie Générale d'Electricité.—" Process for making insulated electric cable joints." 6661. 23rd December, 1942. (608992.)

British Thermostat Co., Ltd., and J. E. Sherlock.—" Thermostatic switch devices for electric ovens, and the like." 6665. 4th March, 1946. (608993.)

H. L. Lambert.—" Centrifugal electric switches." 6670. 4th March, 1946. (608994.) " Mercury and other electricity conducting liquid switches." 6671. 4th March, 1946. (608995.)

Naamlooze Vennootschap Fabriek van Electrische Apparaten Voorheen F. Hazemeijer & Co.—" Magnetic time switch." 6681. 15th March, 1944. (608997.)

H. Miller & Co., Ltd., and W. R. Smith.—"Electric lighting sets for bicycles." 6768. 5th March, 1946. (609057.)

A. H. Stevens (Philco Corporation).—"Absorption device for ultra-high-frequency radiant energy." 6780. 5th March, 1946. (609060.)

Standard Telephones & Cables, Ltd., and J. A. Sage.—"Terminals for electric condensers and like components in sealed containers." 6783. 5th March, 1946. (609061.)

Standard Telephones & Cables, Ltd., and R. M. Barnard.—"Electrical condensers." 6786. 5th March, 1946. (609062.)

British Thermostat Co., Ltd., and J. E. Sherlock.—"Thermostatically operated switch devices." 6817. 5th March, 1946. (609071.)

Cinema-Television, Ltd., and L. C. Bentley.—"Connectors for electric cables and like conductors." 6853. 5th March, 1946. (609081.)

Hoover, Ltd., J. B. Powell and W. W. R. Searle.—"Radio interference suppression." 6860. 5th March, 1946. (609082.)

Simms Motor Units, Ltd., and W. Subak.—"Electromagnetic switches." 6896. 5th March, 1946. (609093.)

Cathodeon, Ltd., and G. Liebmann.—"Television camera." 6930. 6th March, 1946. (609106.)

Unitor Aktieselskabet.—"Connectors for coupling together the ends of movable electric cables." 6945. 6th March, 1945. (609110.)

Automatic Telephone & Electric Co., Ltd., T. B. D. Terroni and J. E. T. Parker.—"Electrical signalling systems." 6961. 6th March, 1946. (609120.)

W. W. Constantine (General Motors Corporation).—"Carbon pile electrical regulator." 6982. 6th March, 1946. (609129.)

General Electric Co., Ltd., and C. R. Dunham.—"Electric motor control systems." 6989. 6th March, 1946. (609132.)

British Thomson-Houston Co., Ltd.—"Dielectric compositions." 6993. 10th March, 1945. (Addition to 571,498.) (609133.)

J. A. Crabtree & Co., Ltd., E. Besag, W. E. Hill and T. D. G. Wintle.—"Trip mechanism of automatic circuit breakers and similar electrical switchgear." 7040. 6th March, 1946. (609143.) "Electric binding posts or terminals." 7042. 6th March, 1946. (609144.)

H. H. Goldstaub.—"Flat rigid electrical heating elements for irons and the like." 7094. 7th March, 1946. (608924.)

Induction Heating Corporation.—"Inductor for high-frequency induction heating." 7117. 12th March, 1945. (609157.)

British Insulated Callender's Cables, Ltd., D. C. Hancock and H. R. Lorch.—"Manufacture of insulated wire and cables for electrical purposes." 7118. 7th March, 1946. (609158.)

Kolster Brandes, Ltd., and C. E. Lock.—"Chassis for telecommunication apparatus." 7131. 7th March, 1946. (608926.)

A. C. Cossor Ltd., A. H. A. Wynn and R. A. Hill.—"Cathode-ray tubes." 7137. 7th March, 1946. (609160.)

General Motors Corporation.—"Limit-switch mechanism for electric motors." 7243. 14th March, 1945. (609171.)

British Thomson-Houston Co., Ltd.—"Preparation of alkylhalogenosilanes." 7245. 15th March, 1945. (609172.) "Alkylation of halogenosilanes." 7246. 15th March, 1945. (609173.)

A. E. Maskell and S. Tepper.—"Safety containers for use with electric irons." 7248. 8th March, 1946. (609174.)

M-O Valve Co., Ltd., and H. T. Ramsay.—"Full-wave grid controlled rectified circuits of the Gratz type." 7270. 8th March, 1946. (609183.)

C. Gruenberg.—"Electric two-part couplings." 7311. 8th March, 1946. (609185.)

A. Benn and H. G. Allen.—"Multiple-socket electrical connectors." 7314. 8th March, 1946. (609188.)

Standard Telephones & Cables, Ltd.—"Transmission line." 7316. 19th March, 1945. (609190.) "Radio beacon system." 7318. 10th March, 1945. (609191.) "High-frequency heating." 7321. 27th March, 1945. (609192.) "High-power ultra-high-frequency load device." 7323. 10th March, 1945. (609193.) "Impulse storage and repeating devices, such as are used in automatic telephone systems." 7324. 31st March, 1945. (609194.) "Electric oscillation generators." 7325. 2nd March, 1944. (609195.) "Electric dry contact rectifiers." 7326. 16th April, 1945. (609196.)

A. D. Carpenter.—"Means for supporting pipes or electric conductors." 7713. 11th July, 1945. (608833.)

Philips Lamps, Ltd.—"Tuning devices." 8424. 16th August, 1941. (608928.) "Devices comprising a plurality of blocking-layer cells." 10599. 24th July, 1941. (608929.)

Western Electric Co., Inc.—"Wave guide switches." 10896. 10th December, 1941. (608839.)

Submarine Signal Co. (London), Ltd., and W. G. Bird.—"Electrical apparatus for submarine sounding and analogous purposes." 14571. 14th May, 1946. (609014.)

Trade Marks

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered within a month from 6th October:—

SILVERLAC. No. 646,082, Class 6. Conduit tubes for electric wires and fittings for such conduit tubes, all being metal goods not included in other classes. No. 671,863, Class 9. Electric switch boxes.—General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

LATIMEX. No. 657,064, Class 9. Electrical apparatus and instruments included in Class 9; and scientific, weighing, signalling and photographic apparatus and instruments.—Stanley Electrical, Ltd., 3, Latimer Road, Teddington.

"PENSOLDA." No. 659,897, Class 9. Electric soldering irons.—A. K. Grant and J. O. Lewis, 10, Burton Hill Bungalows, Malmesbury.

OAKLEY. No. 663,057, Class 9. Electric batteries and accumulators and parts included in Class 9 of all such goods.—Oakley (Wolverhampton), Ltd., Lower Horseley Fields, Wolverhampton.

HIFI. No. 660,981, Class 9. Sound-reproducing apparatus, electric current transformers, choke coils, electronic control apparatus and electrically operated precision measuring instruments.—Hifi, Ltd., Lloyds Bank Chambers, Cape Hill, Smethwick.

ISOBLANKET. No. 664,385, Class 10. Electrically heated blankets, and apparatus employing electrically heated blankets for surgical and curative purposes.—Isopad, Ltd., 14, Poland Street, Oxford Street, London, W.1.

MAGAFLASH. No. B657,651, Class 11. Lighting apparatus and appliances.—Phototechnics, Ltd., 7, Pratt Walk, London, S.E.11.

CONABAR. No. 663,223, Class 11. Tea and coffee making installations (complete); and urns and electric or gas boiling rings, all being parts of such tea and coffee making installations.—"Cona," Ltd., Pirelli House, 343-345, Euston Road, London, N.W.1.

STELLPRO. No. 664,185, Class 11. Installations for lighting, heating, cooking, refrigerating, drying, ventilating, etc.—Steel Products (Southend), Ltd., 143, Victoria Avenue, Southend-on-Sea.

NOMAD. No. 664,228, Class 11. Head-lamps for pedal cycles and for motor cycles.—McKinlay Electrical Mfg. Co., Ltd., 75, Upper Richmond Road, East Putney, London, S.W.15.

CONTRACT INFORMATION

ACCEPTED TENDERS AND PROSPECTIVE ELECTRICAL WORK

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Argentina.—BUENOS AIRES.—Department of Water and Electric Power (Dirección General de Agua y Energia Electrica, Lavalle 1556). 9th December—Supply and erection of pressure pipeline and turbo-alternator sets, etc., for Andalgalá No. 2 hydro-electric power station, Province of Catamarca.

Sanitary Works Department (Obras Sanitarias de la Nación, Charcas 1840): 3rd November—Electric generating set, with switchboard, accessories, etc., for Reconquista power station, Province of Santa Fé. 9th November—Eighty electrically driven centrifugal pumps, eighty l.v. switchboards. 11th November—Three motor-driven deep-well piston pumps.

State Oilfields. 9th November. Automatic telephone exchange and automatic table telephone receivers. (E.P.D. 41241/48. Com./988.)*

Australia.—BRISBANE.—2nd December. City Electric Light Co., Ltd. 120-ton overhead electric travelling crane. (E.P.D. 41319/48. Com./987.)*

Brentford.—British Overseas Airways Corportion. Engine-driven generator sets. (8th October.)

Cleethorpes. — 30th October. Corporation Transport Department. Mercury-arc traction rectifier equipment. (8th October.)

Coventry.—5th November. Housing Committee. Electrical installations in 176 houses. (See this issue.)

India.—NEW DELHI.—16th December. Chief engineer, East Punjab, P.W.D. Electricity Branch. 220-kV, 132-kV and 66-kV transmission line material. (E.P.D. 41266/48. Com./1035.)*

Manchester. — 8th November. North Western Electricity Board. Fire extinguishing equipment. (See this issue.)

Mombasa Island. — 1st March. Complete street lighting scheme for the Island (E.P.D. 41292/48. Com./1020).*

South Africa.—DURBAN.—5th November. City Electricity Department. E.h.v. switchgear. (E.P.D. 41273/48. Com./981.)* 12th November. 33-kV cable. (E.P.D. 41277/48. Com./991.)* 10th December. Air-break switches, lightning arrestors and link switches. (E.P.D. 41275/48. Com./985.)*

JOHANNESBURG. — 9th December. Railway Stores Department. Switchgear and transformers. (E.P.D. 41284/48. Com./977.)* Telephones. (E.P.D. 41285/48. Com./982.)*

CAPE TOWN.—12th January. One 20,000-kVA and one 15,000-kVA transformers. (E.P.D. 41487/48. Com./1055).*

Uruguay.—MONTEVIDEO.—9th November. Usinas Electricas y Telefonos del Estado. Two electric pumping sets. (E.P.D. 41341/48. Com./1044.)*

30th November. Usinas Electricas y Telefonos del Estado. 30,000 metres armoured subterranean cable. (E.P.D. 41215/48. Com./980.)*

* Specifications may be inspected at the Export Promotion Department, Thames House North, Millbank, S.W.1.

Orders Placed

Liverpool.—Corporation. Accepted. Internal wiring of premises at Withnell (£355).—T. Rowlandson. Electrical repairs at the Lodge Lane Baths (£118).—McBride & Nuttall. Re-wiring of the canteen bakehouse at Walton transport depot (£165).—Merseyside and North Wales Electricity Board.

Newcastle-on-Tyne.—Education Committee. Accepted. Electric lighting installation at the Lindfield Primary School (£3,572).—Thomas Sloan.

South Shields.—Town Council. Accepted. Electric vehicle battery (£328).—Crompton Parkinson.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ashington.—Technical college (£250,000); W. W. Tasker, county architect, County Hall, Newcastle-on-Tyne.

Barnet.—Houses (116); U.D.C. engineer and surveyor.

Berwick.—Houses (100); borough engineer.

Billingham-on-Tees.—Houses (78), Roseberry Road site, for U.D.C.; Kitching & Co., architects, 21, Albert Road, Middlesbrough.

Bristol.—Paint packing and storage premises, Brislington; Lewis Berger & Sons, Ltd., Morning Lane, London, E.9.

Broughton (Lancs).—Factory, Lower Broughton Road, for J. Lee & Co. (Leeprufe), Ltd.; Clifford Wild, architect, 72, Bridge Street, Manchester, 2.

Canterbury.—New Simon Langton girls' school, Old Dover Road (£230,908); Ringmer Building Works, Ringmer, East Sussex.

Cardiff.—Extensions, Hensol Park Hospital; Welsh Regional Hospital Board, Cathays Park.

Chesterfield.—Civic restaurant, Beetwell Street; borough engineer, Town Hall.

Coppull.—Day schools (£49,000), for Parish Church authorities; Rev. J. Whittaker, The Vicarage, Coppull, near Chorley.

Darlaston.—Extensions to works for Wellman Smith Owen Engineering Corporation, Ltd., Willenhall Road; secretary.

Deal.—Houses (50), Orchard Avenue, for T.C.; Geo. Parker & Sons, Ltd., 124, Sumner Road, S.E.15, builders.

Doncaster.—School of Art (£143,000); borough engineer.

Exeter.—Houses (100), Countess Wear site; city architect.

Heaton Mersey.—Laboratory and offices at works, Vale Road; Melland & Coward, Ltd.

Ilford.—Maisonettes (70) and houses (14), Fulwell Avenue; borough engineer.

Kidsgrove.—Houses (82), Ashenough estate; R. Gethin, U.D.C. surveyor, Town Hall, Kidsgrove, Stoke-on-Trent.

Lanark.—Conversion of Kersewell Mansion into a college for T.C.; Cullen, Lochhead & Brown, architects, 119, Cadzow Street, Hamilton.

Leigh (Lancs).—Extensions to technical college; county architect, Preston.

Leith.—Rebuilding Leith Sailors' Home (£30,000); British Sailors' Society, 45, Hope Street, Glasgow, C.2.

London. — FULHAM. — Development of Hurlingham polo ground for about 400 flats (£750,000); borough engineer, Town Hall, Fulham, S.W.6.

BETHNAL GREEN.—Six blocks of dwellings, Avebury estate, for the L.C.C.; Allen Fairhead & Sons, Ltd., builders, Sydney Road, Enfield.

FOREST GATE.—Block of flats, Colva Road; H. Sockel, 2, Blakehall Crescent, Wanstead, E.11.

SOHO.—Office block, Soho Square and Dean Street; L. C. Norton, architect, 16, Clifford Street, W.1.

WESTMINSTER.—Block of Government offices, Whitehall; plans, Ministry of Works, Abell House, John Islip Street, S.W.1.

Machynlleth.—Permanent houses (34) for U.D.C.; W. B. Bond, quantity surveyor, 3, Newhall Street, Birmingham, 3.

Manchester.—Offices, workshop and showroom, Knott Mill, for Lancashire Motor Trades, Ltd.; G. Bullimore, architect, 208, Bramhall Lane, Davenport, near Stockport.

Flats (40), Butler Street and Ravald Street, Ancoats, for Housing Committee; A. Mackenzie, housing director, Town Hall.

Newcastle-on-Tyne.—Additions to gear works in Staines Road for Angus & Co., Ltd.; S. W. Milburn & Partners, architects, 9, Esplanade, Sunderland.

Newcastle (Staffs).—Primary school, Bradwell estate; J. W. Tonge, borough surveyor, Municipal Buildings.

Northumberland.—School, Ovington; county architect, County Hall, Newcastle-on-Tyne.

Plymouth.—Oil refinery, Millbrook; Trinidad Leaseholds, Ltd., Salisbury House, London, E.C.2.

Reading.—Blocks of flats, Downshire Square; H. E. Foreman, architect, Newlyn, Orchard Avenue, Windsor.

Ruislip-Northwood.—Maisonettes (56) and flats (16), Eastcote and South Ruislip, for U.D.C.; surveyor, Council Offices, Northwood.

Salisbury.—New buildings at Cathedral Close (£250,000) for Diocesan Training College governors; W. Curtis Green, architect, 5, Pickering Place, St. James's Street, London, S.W.1.

Sedgley.—Houses (42) for U.D.C.; McKewan, Fillmore & McKewan, architects, 8, Newhall Street, Birmingham, 3.

Smethwick.—Workshop, garage and canteen block, Rabone Lane, for T.C.; Jackson & Edmonds, architects, 65, New Street, Birmingham.

South Shields.—Houses (62), Mardens Road estate; borough engineer.

Houses (50); William Leech, Ltd., builders, Clayton Street, Newcastle-on-Tyne.

Spalding.—Houses (88) for R.D.C.; F. B. Saunders, architect, 10, The Crescent.

Stockport.—Motor showroom, service station and garage; J. Cresswell, Buxton Road, Great Moor.

Swaffham (Norfolk).—Houses (50), Mundford Cross Roads; Forestry Commission, 25, Savile Row, London, W.1.

Swanscombe.—Workshops and cold storage, Milton Street; G. E. Clay & Partners, architects, 198, Parrock Street, Gravesend.

Swansea.—Second section of new grammar school for E.C.; borough architect, Guildhall.

Warrington.—Methodist church on Westy Lane estate; superintendent minister, Methodist Church Circuit.

Wellington.—Houses (40), High Ercall and Tibberton, for R.D.C.; J. Brian Cooper, architect, 177, Corporation Street, Birmingham.

Whitley Bay.—Reconstruction of factory, Victoria Mews, for John Favours, Ltd.; J. F. Dawson, builder, Ilfracombe Gardens.

Widnes.—Traditional dwellings (68), Crow Wood; F. Mellor, borough architect, Brendan House, Widnes Road.

Winchester.—Houses and flats (66); A. S. Wilson & Partners, architects, 8 Princes Street, Storey's Gate, Westminster, S.W.1.

Wisbech.—Permanent houses (38); G. J. Wootton, borough engineer, Exchange Square.

Wishaw.—Ice cream factory; J. L. Ross, architect, 82, Main Street.

Wrexham.—Extensions to Denbighshire Technical College; G. D. Wiles, county architect, Grove Park, Wrexham.